# WEBER STATE UNIVERSITY
# STUDENT ACTIVITY CENTER ADDITION
# TO
# THE STROMBERG ATHLETIC COMPLEX

**OGDEN, UTAH**

**OWNER**

**THE STATE OF UTAH**
**DIVISION OF FACILITIES AND CONSTRUCTION MANAGEMENT**
**4110 STATE OFFICE BUILDING**
**SALT LAKE CITY, UTAH**

# BID SET

# VOLUME 1

**DIVISIONS 0 THRU 14**

**03 OCTOBER 2012**

VCBO ARCHITECTURE
524 SOUTH 600 EAST
SALT LAKE CITY
UTAH 84102
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# PROJECT MANUAL

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## SECTION 00 3100

## AVAILABLE PROJECT INFORMATION

### PART 1 - GENERAL

### 1.1 AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

A. The electronic files will be distributed from the Architect to the General Contractor only once the following form has been signed. It will be the General Contractor's responsibility to control distribution.

B. Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these drawing files. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

C. Any and all users who may obtain these drawings **from the General Contractor** under this agreement, including but not limited to; subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files including data contained in the files without the prior written consent of the Architect.

D. Building Information Model (BIM) drawing files will be made available to the Contractor and its subcontractors for the purposes of preparing submittals for their portion of the work **only** after the "Agreement Concerning Drawing Files on Electronic Media" has been signed by the General Contractor.

### PART 2 - PRODUCTS - Not Used

### PART 3 - EXECUTION – Not Used

**END OF SECTION**

## AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these digital models. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

**Any and all users who may obtain these digital models from the General Contractor under this agreement, including but not limited to; subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files without the prior written consent of the Architect.**

Under no circumstances shall delivery of the electronic digital models be deemed a sale by the Architect, and the Architect makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall the Architect be liable for any loss of profit or any consequential damages as a result of the use or reuse of the electronic files.

The digital Building Information Models provided will contain information as provided on construction documents. The user shall remove all notes, text, detail cuts and member designations from the electronic file prior to use. If used as submittal documents, submittals will be rejected if non-compliant. The drawing files provided by VCBO may not be reproduced or distributed to individuals outside the company or collective organization signing this agreement.

**LIST OF DRAWINGS:**

Project Name: **WSU STUDENT ACTIVITY CENTER -STROMBERG ATHLETIC COMPLEX**
VCBO Project **# 12475**

List of Revit Models: **Architectural, Structural, Mechanical and Electrical.**

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**ACCEPTANCE OF TERMS, CONDITIONS & LIMITATIONS:**

| | |
|---|---|
| _____ | _____ |
| Name of Company/Contractor | Signature of Company/Contractor Representative |
| _____ | |
| Printed Name of Individual Signing | |
| _____ | _____ |
| Position/Title | Date |

**This agreement must be signed and returned to VCBO prior to release of any electronic document.**

## SECTION 00 0350

## EXEMPTION CERTIFICATE

### PART 1 - GENERAL

### 1.1 SUMMARY

A. Weber State University will take advantage of the Utah Tax Exempt Law which became effective January 1, 1996. The appropriate Tax Exempt Form must be used by the vendor when purchasing construction materials for all University projects. A copy of the Form which has been completed and signed by the University's Director of Purchasing and Support Services or other authorized individual may be obtained from the University.

B. Contractor assumes all responsibility for correct use of exemption form and for filing all necessary paperwork with the State of Utah, including all costs associated with audits or other reviews required by the State.

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## SECTION 00 0380

## GEOTECHNICAL DATA

### PART 1 - GENERAL

### 1.1 SUMMARY

A. Geotechnical investigation report was prepared by GSH Geotechnical, Inc., 473 West 4800 South, Salt Lake City, Utah 84123.

B. Inclusion of soils investigation is for contractor **information only**, and **is not part of the Contract Documents**. Recommendations and provisions of the Geotechnical Investigation apply to work of this contract. The Contractor is responsible for all requirements and provisions either outlined or detailed in the Geotechnical Investigation.

### 1.2 REPORT

A. The report is dated May 21, 2012.

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**REPORT**
**GEOTECHNICAL STUDY**
**PROPOSED STROMBERG ATHLETIC COMPLEX ADDITION**
**WEBER STATE UNIVERSITY**
**OGDEN, UTAH**

Submitted To:

VCBO Architecture
524 South 600 East
Salt Lake City, Utah 84102

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123

May 21, 2012

Job No. 0068-015-12

May 21, 2012
Job No. 0068-015-12

VCBO Architecture
524 South 600 East
Salt Lake City, Utah 84102

**Attention: Mr. Brent Tippets**

Gentlemen:

Re: Report
Geotechnical Study
Proposed Stromberg Athletic Complex Addition
Weber State University
Ogden, Utah

## 1. INTRODUCTION

### 1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Stromberg Athletic Complex Addition - Weber State University, which is in Ogden, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A more detailed aerial view of the site showing the proposed addition location and existing facilities is presented on Figure 2, Site Plan. The locations of the borings drilled in conjunction with this study are also presented on Figure 2.

During the course of this study, many of the conclusions and potential recommendations were presented to the design team.

### 1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Brent Tippets of VCBO Architecture and Mr. Alan Spilker of GSH Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this study were to:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123
Tel: (801) 685-9190 Fax: (801) 685-2990
www.gshgeo.com

1. Accurately define and evaluate the subsurface soil and groundwater conditions across the site.
2. Provide appropriate foundation, earthwork, and pavement recommendations to be utilized in the design and construction of the proposed development or structure.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the drilling, logging, and sampling of 4 borings.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

## 1.3 AUTHORIZATION

Authorization was provided by a signed "Letter of Assignment (Short Form Agreement)" from VCBO Architecture dated April 23, 2012.

## 1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

# 2. PROPOSED CONSTRUCTION

The project consists of an addition to the existing Stromberg Complex building. The addition will be located across the existing asphalt parking just west of the existing building. The addition will include a 2-story fitness and exercise space, locker rooms, and other supporting facilities. New construction will likely consist of steel or wood framing with masonry walls. GSH anticipates that the floor level of the addition will tie into the adjacent floor level of the existing building and be constructed slab-on-grade with no below-grade level.

Maximum column and wall loads are anticipated to be on the order of 150 to 200 kips and 5 to 8 kips per lineal foot, respectively. Maximum slab-on-grade loads are anticipated to be less than 200 pounds per square foot.
Site development will require a moderate amount of earthwork in the form of site grading. We estimate that maximum cuts and fills (if rammed aggregate piers are to be utilized) to achieve design grades will be on the order of 2 to 5 feet.

## 3. INVESTIGATIONS

### 3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 4 borings were explored to depths of 31.5 feet below existing grade. The borings were drilled using a truck-mounted drill rig equipped with hollow-stem augers and auto hammer. Locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3D, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

A 3.25-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) was utilized in the majority of the subsurface sampling at the site. Additionally, a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) was utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of drilling operations, one and one-quarter-inch diameter slotted PVC pipe was installed in each boring in order to provide a means of monitoring the groundwater fluctuations.

### 3.2 LABORATORY TESTING

#### 3.2.1 General

In order to provide data necessary for our engineering analyses, a laboratory testing program was performed. The program included moisture and density, partial gradation, consolidation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

### 3.2.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3D.

### 3.2.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below:

| Boring No. | Depth (feet) | Percent Passing No. 200 Sieve | Soil Classification |
|---|---|---|---|
| B-1 | 22.5 | 18.0 | SM |
| B-1 | 30.5 | 18.8 | SM |
| B-2 | 20.5 | 10.1 | SP/SM |
| B-2 | 25.5 | 12.6 | SM |
| B-2 | 30.5 | 10.6 | SP/SM |
| B-3 | 20.5 | 5.2 | SP/SM |
| B-4 | 20.0 | 5.5 | SP/SM |
| B-4 | 25.5 | 1.8 | SP |
| B-4 | 30.5 | 18.0 | SM |

### 3.2.4 Consolidation Test

To provide data necessary for our settlement analyses, a consolidation test was performed upon a representative sample of the fine-grained clay fill soils encountered in Boring B-2 at a depth of 7.5 feet. The results indicate that the finer-grained clay fill soils are slightly over-consolidated and will exhibit moderate compressibility characteristics when loaded below the over-consolidation pressure. The clay fill soils were likely only compacted to 90 percent of the maximum density (Modified Proctor). Detailed results of the test are maintained within our files and can be transmitted to you, upon your request.

### 3.2.5 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the silty clay soils encountered in Boring B-1 at a depth of 2.5 feet below existing grade. The results of the chemical tests are tabulated on the following page.

| Boring No. | Depth (feet) | pH | Total Water Soluble Sulfate (mg/kg-dry) |
|---|---|---|---|
| B-1 | 2.5 | 8.90 | 31.4 |

## 3.3 SUBSURFACE SOIL AND GROUNDWATER

All 4 borings completed are within an asphalt-paved parking area. The existing pavement section encountered at the boring locations consists of 2.5 to 4.0 inches of asphalt over 7.0 to 9.0 inches of aggregate base.

Below the pavement, fills were encountered to depths ranging from 7.0 feet below grade in Borings B-3 and B-4 to 9.0 and 16.5 feet in Borings B-2 and B-1, respectively. These fills consist of silty sands and silty/sandy clays. These fills are loose to medium dense/medium stiff to stiff, moist, light brown to brown in color, and likely were placed as site grading structural fills for the existing structure. However, unless these fills are certified as structural fill with supporting documentation, they must be considered non-engineered.

Below the fills in Boring B-2, natural sandy clay was encountered to a depth of 13.5 feet underlain by fine sand with trace to some silt to the full depth penetrated, 31.5 feet. Below the fills in Borings B-1, B-3 and B-4, natural fine to medium sand with varying silt content was encountered.

The natural clay soil is stiff, moist, and brown in color. Natural sands are loose to medium dense, moist to saturated, brown and gray in color.

The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In-situ, the transition between soil types may be gradual.

## 3.4 GROUNDWATER

Groundwater was measured individually following drilling and at 5 and 13 days thereafter. The difference in groundwater levels measured at 5 and 13 days was insignificant. Groundwater measurements are tabulated on the following page.

| Boring No. | Groundwater Depth (feet-inches) | |
|---|---|---|
| | May 04, 2012* | May 17, 2012 |
| B-1 | 20-0 | 17-2 |
| B-2 | 20-0 | 15-8 |
| B-3 | 20-0 | 21-7 |
| B-4 | 19-6 | Unable to obtain due to parked vehicle |

* During drilling; not stabilized.

## 4. DISCUSSIONS AND RECOMMENDATIONS

### 4.1 SUMMARY OF FINDINGS

The most significant geotechnical aspects of the site are the 7.0 to 16.5 feet of surficial fills and the loose saturated sands encountered between 17.0 and 31.5 feet.

Variability of surficial fill thickness should be expected throughout the proposed site, both laterally and vertically. The surficial fill encountered may likely have been placed and compacted as structural site grading fill. However, if left below the new building and exterior flatwork, these fills must be certified as structural fill with supporting documentation or be improved through ground improvement methods. Additionally, these fills, due to their locations within a parking area, were likely only compacted to a density of 90 percent of a Modified Proctor and would not meet the requirement of 95 percent as presented within this report.

Our calculations indicated that the loose saturated sand soils in Borings B-1, B-2, and B-4 could liquefy during the design seismic event. Additionally, with the overall sloping topography in the area and the relatively consistent layer of liquefiable soils, lateral spread may be possible. Settlements associated with the liquefaction potential of the saturated sand soils could be as high as 3 to 4 inches. Due to liquefaction-induced settlements and the potential for lateral spread, GSH recommends that rammed aggregate displacement piers/stone columns be utilized to mitigate any potential soil movement during the design seismic event. Additionally, if aggregate piers are to be used, the upper 7.0 to 16.5 feet of surficial fills would not need to be removed but would be stabilized in-place by the piers. GSH anticipates that aggregate piers will extend to depths of 40 feet. However, follow-up Cone Penetrometer Testing (CPT) would be beneficial to fine tune these depths.

As an alternative to aggregate piers, a deep area drain system may be utilized. Liquefaction can only occur in saturated sand/gravel soils; therefore, if the groundwater is reduced to a depth of 30 to 35 feet below the ground surface, the potential for liquefaction is eliminated. Due to the

steep slope beyond the west side of the site, horizontal drains would be feasible. If a deep area drain is utilized, the 7.0 to 16.5 feet of surficial fills would need to be removed and replaced under footings. Floor slab may be established on the existing fills if the upper 12 inches is scarified and recompacted to the requirements of structural fills.

The existing fills and natural soils can be re-used as structural site grading fill if they meet the requirements of such. Fine-grained soils will require close moisture control during placement and compaction.

Detailed discussions pertaining to earthwork, foundations, floor slabs, lateral resistance, pavements, and the geoseismic setting of the site are discussed in the following sections.

## 4.2 EARTHWORK

### 4.2.1 Site Preparation

Initial site preparation will consist of the demolition and removal of the existing pavements, debris, surface vegetation, topsoil, root bulbs, sod, and any other deleterious materials from beneath an area extending out at least 3 feet from the perimeter of the proposed addition and exterior flatwork areas. Existing utilities will need to be properly abandoned and/or relocated.

Subsequent to stripping and prior to the placement of floor slabs, structural site grading fill and pavements, the exposed subgrade, consisting of disturbed or undisturbed natural soils, must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed to a maximum depth of 2 feet and replaced with structural fill.

### 4.2.2 Excavations

For fine-grained (cohesive) soils, temporary construction excavations not exceeding 4 feet may be excavated near vertical. For granular (cohesionless) soils, temporary construction excavations not exceeding 4 feet should be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 16.5 feet in fine-grained or granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1.0H:1.0V). Temporary excavations encountering loose, relatively clean, and/or saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering. Temporary excavations deeper than 16.5 feet are not anticipated at the site.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated and GSH contacted.

### 4.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, flatwork, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and potential replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as structural fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall not exceed 4 inches; although, occasional larger particles, not exceeding 8 inches in diameter, may be incorporated if placed randomly in a manner such that "honeycombing" does not occur and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas shall be restricted to 2 inches.

On-site soils, including non-engineered fills, may be re-utilized as structural site grading fill if they meet the requirements of such. However, utilization of the fine-grained soils (clays and silts) as structural site grading fill will require tight moisture control which <u>will be very difficult, if not impossible</u>, during wet and cold periods of the year.

Only granular soils are recommended as structural fill in confined areas, such as around foundations, within utility trenches, and as replacement fill below foundations.

Imported granular structural fill should consist of a fairly well-graded mixture of sand and gravel with less than 20 percent fines (clays and silts).

Non-structural site grading fill is defined as all fill material not designated as structural fill and may consist of any cohesive or granular soils not containing excessive amounts of degradable material.

### 4.2.4 Fill Placement and Compaction

All structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria in accordance with the table on the following page.

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[1] American Association of State Highway and Transportation Officials
[2] American Society for Testing and Materials

| Location | Total Fill Thickness (feet) | Minimum Percentage of Maximum Dry Density |
|---|---|---|
| Beneath an area extending at least 5 feet beyond the perimeter of the structure | 0 to 10 | 95 |
| Outside area defined above | 0 to 5 | 90 |
| Outside area defined above | 5 to 10 | 95 |

Structural fills greater than 10 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade shall be prepared as discussed in Section 4.2.1, Site Preparation, of this report. In confined areas, subgrade preparation should consist of the removal of all loose or disturbed soils.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

### 4.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they shall be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction.

Fine-grained cohesive soils are not recommended for use as trench backfill.

## 4.3 FOUNDATIONS

### 4.3.1 General

Spread and continuous wall foundations placed overlying rammed aggregate displacement piers/stone columns are discussed in the following sections. Additional deep foundation types, including helical pier, driven steel pile, and micro-pile recommendations, can be provided at the request of the client.

### 4.3.2 Displacement Rammed Aggregate Pier®/Stone Columns

Displacement Rammed Aggregate Pier®/stone column soil improvement is installed by pushing a 1-piece, hollow mandrel to the design depth, displacing the existing soil and building columns of compacted aggregate using a bottom-feed method and a vertical compaction hammer to compact 12-inch thick lifts of clean aggregate. The compacted aggregate will be non-liquefiable and the soil surrounding each pier will be densified through the displacement of the native soil.

Displacement Rammed Aggregate Pier®/stone column will support building foundations, provide settlement control for static loads, and mitigate liquefaction potential within the improved zone. For mitigation of liquefaction potential, the zone of improvement should extend one row of piers outside the building footprint.

Piers are typically 20 to 27 inches in diameter and installed in a grid pattern across the building area at a spacing sufficient to limit the potential for liquefaction between piers, based on the seismic design parameters provided in this report. We estimate that a spacing of 7 to 8 feet would be sufficient at this site to provide the required improvement.

We anticipate that the Displacement Rammed Aggregate Pier®/stone columns system and the conventional spread and continuous wall foundations can be proportioned utilizing a net bearing pressure in the range of 4,500 to 5,000 pounds per square foot. Generally, we anticipate that the wall footings will require some additional reinforcing but will not need to be designed as grade beams. With these systems, the settlement should be controllable to less than one inch.

Displacement Rammed Aggregate Pier®/stone columns soil reinforcement should be designed and constructed by an installer licensed by the Geopiers® Foundation Company, Inc./Nicholson Construction or Jones Drilling & Shoring. The installer should provide a Displacement Rammed Aggregate Pier®/stone columns layout and detailed design calculations sealed by a professional engineer licensed in the State of Utah. The design calculations should demonstrate that Displacement Rammed Aggregate Pier®/stone columns soil reinforcement is designed to control settlement to magnitudes within the criteria for this project.

The local contact for Displacement Rammed Aggregate Pier® is Mr. David Plehn (801-269-8012). The local contacts for stone columns are Nicholson Construction [Mr. Mark Goodsell (801-296-5899)] and Jones Drilling & Shoring [Mr. Kevin Garside

(801-280-2557)]. Final design will be provided by the Displacement Rammed Aggregate Pier®/stone columns contractor selected.

### 4.3.3 Spread And Continuous Wall Foundations

#### 4.3.3.1 Design Data

Once the Displacement Rammed Aggregate Pier®/stone columns systems are installed, the proposed structure can be supported upon conventional spread and continuous wall foundations established directly upon the undisturbed top surface of the Displacement Rammed Aggregate Pier®/stone columns. As previously discussed, the structure may also be supported upon deep foundation systems such as helical pier, drilled shafts, or driven piles.

As an alternative to soil improvements, a deep area drain may be utilized to reduce the groundwater depth to 30 to 35 feet. With the reduced groundwater depth, the proposed structure may be supported upon conventional spread and continuous wall foundations supported upon structural fill extending to suitable natural soils. This alternative would require that 7.0 to 16.5 feet of fills be removed under footings and replaced with granular structural fill. For design, the following parameters are provided:

| | |
|---|---|
| Minimum Recommended Depth of Embedment for Frost Protection | - 30 inches |
| Minimum Recommended Depth of Embedment for Non-frost Conditions | - 15 inches |
| Recommended Minimum Width for Continuous Wall Footings | - 16 inches |
| Minimum Recommended Width for Isolated Spread Footings | - 30 inches |
| Recommended Net Bearing Pressure for Real Load Conditions | |
| Footings Overlying Displacement Rammed Aggregate Pier®/stone columns | - Approximately 5,000 pounds per square foot* |
| Footings Overlying Structural Fill Extending to Suitable Natural Soils | - 3,000 pounds per square foot |

| | |
|---|---|
| Bearing Pressure Increase for Seismic Loading | - 50 percent |

* To be developed by Displacement Rammed Aggregate Pier®/foundation installer

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

### 4.3.4 Installation

Under no circumstances shall the footings be established overlying potentially collapsible soils, non-engineered fills, loose or disturbed soils, sod, rubbish, topsoil, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill. If granular soils become loose or disturbed, they must be recompacted to the requirements for structural fill.

The width of structural replacement fill below footings shall be equal to the width of the footing plus one foot for each foot of fill thickness.

Where Displacement Rammed Aggregate Pier®/stone columns are utilized, foundations must be established directly upon the undisturbed tops of the pier systems. Prior to installing Displacement Rammed Aggregate Pier®/stone columns, all site grading activities should be completed.

### 4.3.5 Settlements

Maximum settlements of foundations, designed and installed over Displacement Rammed Aggregate Pier®/stone columns, should be designed to less than one-half inch. However, these estimates will be refined with the design of the system. Settlements for foundations installed on structural fill, extending to suitable natural soils for the alternative, should be designed to less than one inch.

## 4.4 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 should be utilized. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

## 4.5 LATERAL PRESSURES

The building is to be constructed slab-on-grade. However, for the purpose of potential shallow subgrade structures 4 feet or less below the surface, such as utility boxes etc., the following lateral pressure discussion is provided.
The lateral pressure parameters, as presented within this section, are for backfills, which will consist of drained granular soil placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid walls, generally not exceeding 8 feet in height, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

For seismic loading and below-grade walls up to 4 feet tall, uniform a pressure of 30 and 60 pounds per square foot should be added for active and more rigid walls, respectively.

## 4.6 FLOOR SLABS

Floor slabs may be established upon properly prepared, improved subgrade soils and/or structurally supported on deep foundations. In order to facilitate curing of the concrete, it is recommended that floor slabs, if established on properly prepared subgrade, be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or three-quarters to one-inch minus clean gap-graded gravel. Settlements of lightly to moderately loaded floor slabs are anticipated to be minor.

## 4.7 CEMENT TYPES

The laboratory tests indicate that the natural soils tested contain a negligible amount of water soluble sulfates. Based on our test results, concrete in contact with the on-site soil will have a low potential for sulfate reaction (ACI 318, Table 4.3.1). Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

## 4.8 GEOSEISMIC SETTING

### 4.8.1 General

Utah municipalities have adopted the International Building Code (IBC) 2009. The IBC 2009 code determines the seismic hazard for a site based upon 2002 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structure must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2009 edition.

### 4.8.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault is the Ogden portion of the Wasatch Fault, approximately one-half mile east of the site.

### 4.8.3 Soil Class

Our analysis shows that loose saturated sands between 17.0 and 31.5 feet could liquefy during the design seismic event (see Section 4.8.5, Liquefaction). According to the IBC 2009 Table 1613.5.2, "Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils..." are designated under site Class F and require a site specific response analysis.

However, with ground improvement such as Displacement Rammed Aggregate Pier®/stone columns and/or supporting the structure on deep foundations, it is our opinion that for design, the site be designated under Site Class D - Stiff Soil Profile for design. Additionally, if groundwater is reduced to a depth of 30 to 35 feet, a Site Class D should also be used.

### 4.8.4 Ground Motions

The IBC 2009 code is based on 2002 USGS mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (41.1908 degrees north and 111.9437 degrees west, respectively), the values for this site are tabulated on the following page.

| Spectral Acceleration Value, T Seconds | Site Class B-C Boundary [mapped values] (% g) | Site Class D [adjusted for site class effects] (% g) |
|---|---|---|
| Peak Ground Acceleration | 55.8 | 55.8 |
| 0.2 Seconds, (Short Period Acceleration) | $S_S = 139.4$ | $S_{MS} = 139.4$ |
| 1.0 Seconds (Long Period Acceleration) | $S_1 = 58.1$ | $S_{M1} = 87.1$ |

The IBC 2009 code design accelerations ($S_{DS}$ and $S_{D1}$) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds (⅔).

### 4.8.5 Liquefaction

The site is located in an area that has been identified by the Utah Earthquake Preparedness Information Center Utah Division of Comprehensive Emergency Management for Weber County as having "Low to Moderate" liquefaction potential. Liquefaction is defined as the condition when saturated, loose, granular soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will not liquefy during a major seismic event.

Our analysis indicates that the saturated sand soils between 17.0 and 31.5 feet could liquefy during the design seismic event. Additionally, with local topography and continuous loose layers, lateral spread may also occur. Ground rupture is not likely to occur.

As previously mentioned, ground improvement or the reduction of groundwater level will reduce or eliminate potential liquefaction at the site.

Calculations were performed using the procedures described in the 2008 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[3].

[3] Idriss, I. M., and Boulanger, R. W. (2008), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

**GSH Geotechnical, Inc.**

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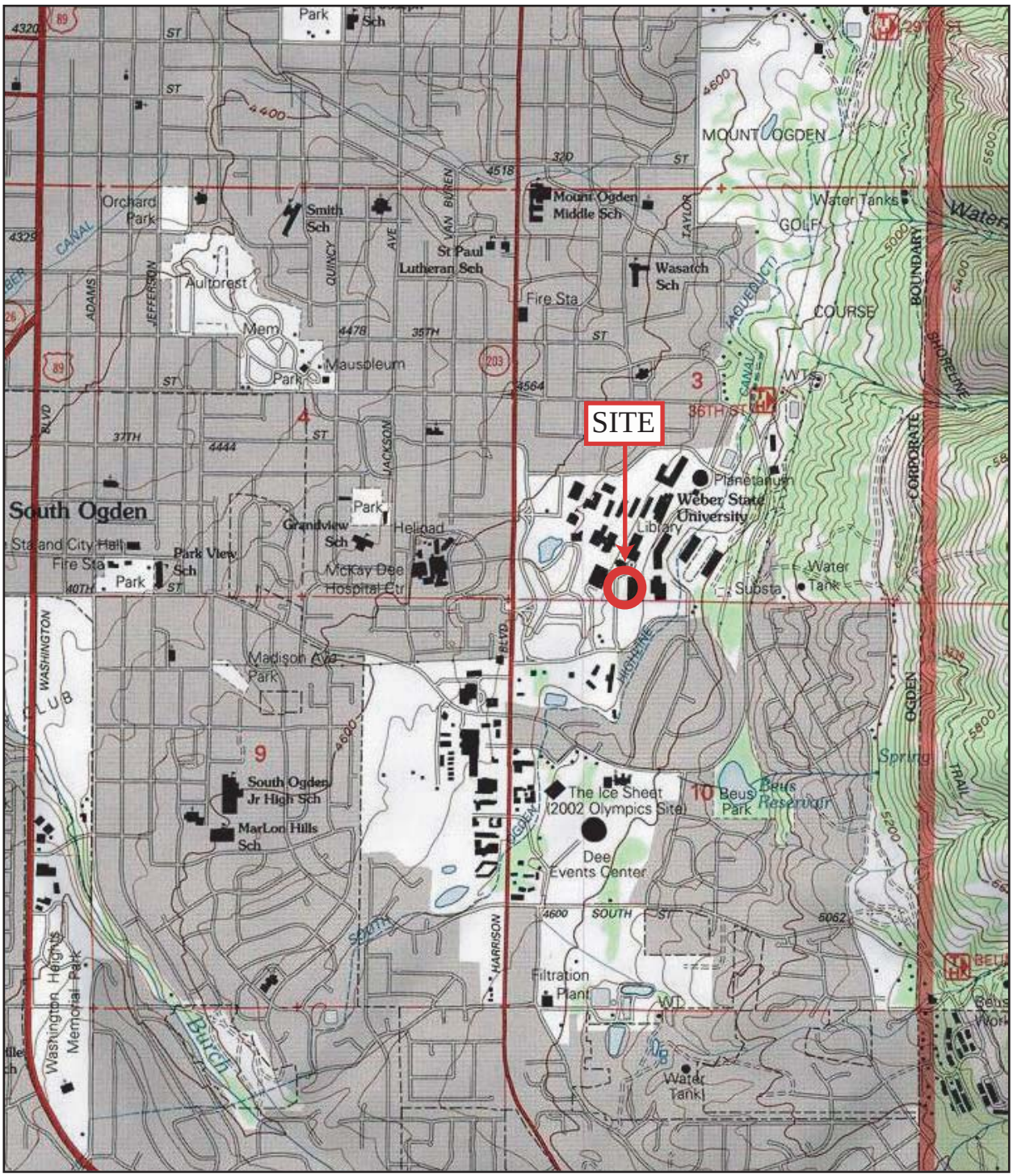
BNR/ADS:jlh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3D, Log of Borings
Figure 4, Key to Boring Log (USCS)

Addressee (3 + email)

VCBO ARCHITECTURE
JOB NO. 0068-015-12




SCALE IN FEET

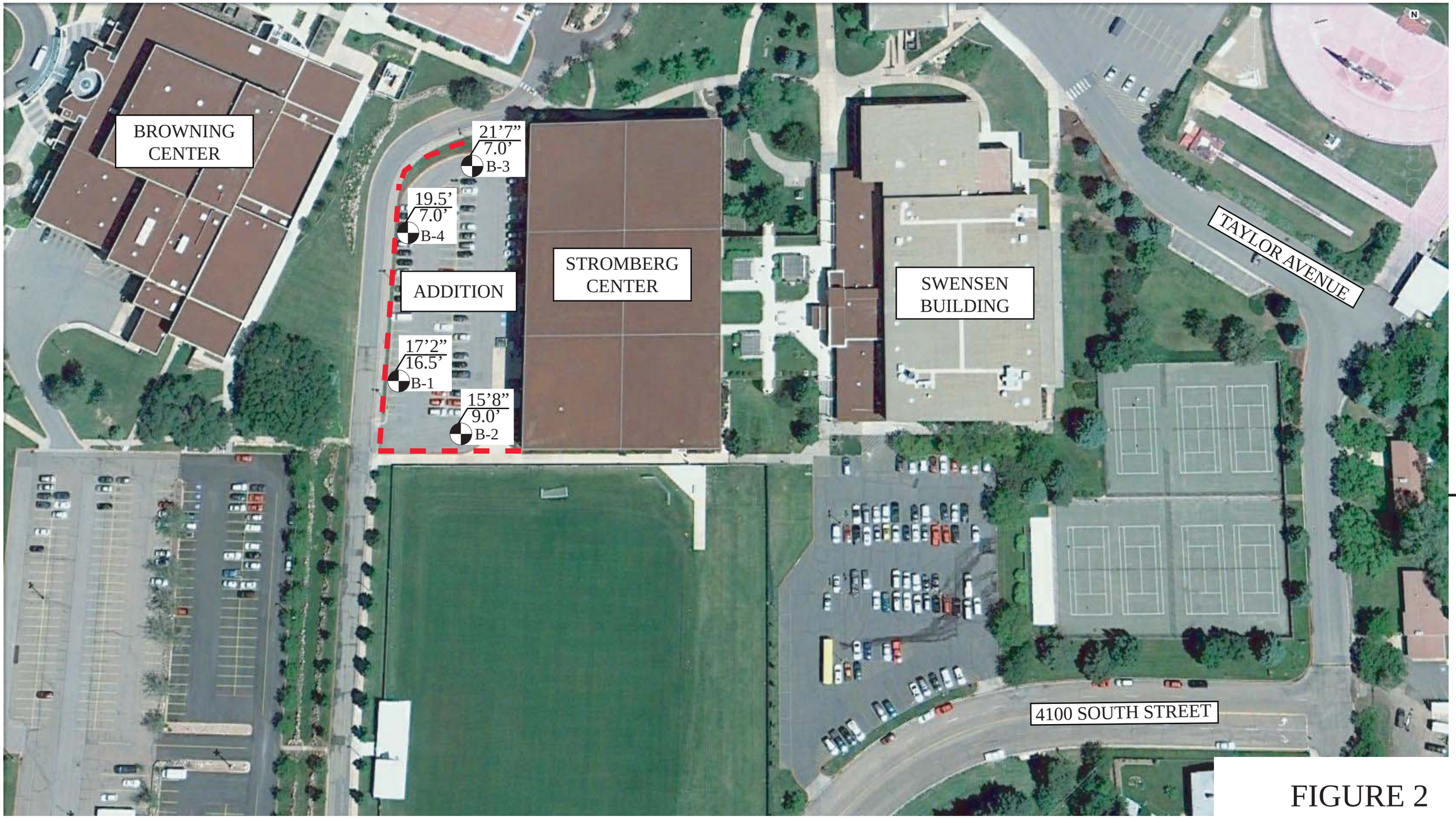
1000 0 1000 2000

# FIGURE 1
# VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "OGDEN, UTAH" DATED 1998

GSH

VCBO ARCHITECTURE
JOB NO. 0068-015-12




REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY DATE 06/17/2010

KEY:
Boring Location
Groundwater Depth / Fill Depth

APPROXIMATE SCALE 1” = 94’

FIGURE 2
SITE PLAN

GSH

# GSH

# BORING LOG



## BORING: B-1

**CLIENT:** VCBO Architecture
**PROJECT NUMBER:** 0068-015-12
**PROJECT:** Stromberg Athletic Complex Addition
**DATE STARTED:** 5-4-12
**LOCATION:** Weber State University Campus, Ogden, Utah
**DATE FINISHED:** 5-4-12
**GSH Field Rep.:** HRW
**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger
**HAMMER:** Automatic
**WEIGHT:** 140 lbs
**DROP:** 30"
**GROUNDWATER DEPTH:** 20' (5/4/12) 17' 2" (5/9/12) 17'2" (5/17/12)
**ELEVATION:** ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | |
| | | **3.5" ASPHALT ON 8.5" BASE** | 0 | | | | | | | | moist<br>loose |
| | SM<br>FILL | **SILTY FINE SAND, FILL**<br>with trace medium to coarse sand and trace fine gravel; brown | | | | | | | | | |
| | | | | 20 | | | | | | | |
| | | | 5 | 48 | | | | | | | medium dense |
| | | | 10 | 16 | | | | | | | loose |
| | | grades with some clay | | | | | | | | | |
| | | | 15 | 16 | | | | | | | |
| ▼ | SM | **SILTY FINE SAND**<br>dark greenish-gray | | | | | | | | | moist<br>loose |
| | | | 20 | 5 | | | | | | | saturated<br>very loose |
| | | | | 10 | | 22.2 | | 18.0 | | | medium dense |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

# BORING LOG



**BORING: B-1**

**CLIENT:** VCBO Architecture **PROJECT NUMBER:** 0068-015-12

**PROJECT:** Stromberg Athletic Complex Addition **DATE STARTED:** 5-4-12

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 25 | | | | | | | | |
| | | | | 14 | | | | | | | |
| | | | 30 | | | | | | | | |
| | | grades dark gray/brown | | 7 | | 22.7 | | 18.8 | | | loose |
| | | Stopped drilling at 30.0'.<br>Installed 1-1/4'' diameter slotted PVC pipe to 30.0'. | 35 | | | | | | | | |
| | | | 40 | | | | | | | | |
| | | | 45 | | | | | | | | |
| | | | 50 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
(cont'd)

# BORING LOG



**BORING: B-2**

**CLIENT:** VCBO Architecture
**PROJECT NUMBER:** 0068-015-12
**PROJECT:** Stromberg Athletic Complex Addition
**DATE STARTED:** 5-4-12
**LOCATION:** Weber State University Campus, Ogden, Utah
**DATE FINISHED:** 5-4-12
**GSH Field Rep.:** HRW
**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger
**HAMMER:** Automatic
**WEIGHT:** 140 lbs
**DROP:** 30"
**GROUNDWATER DEPTH:** 20' (5/4/12) 15' 9" (5/9/12) 15' 8" (5/17/12)
**ELEVATION:** ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | 0 | | | | | | | | |
| | | **4.0" ASPHALT ON 7.0" BASE** | | | | | | | | | moist<br>medium dense |
| | SM<br>FILL | **SILTY FINE SAND, FILL**<br>with trace medium to coarse sand and trace fine and coarse gravel; brown | | 30 | | | | | | | |
| | | Refusal at 5.5' on cobbles/boulder; moved north approximately 10.0' | 5 | 18 | | | | | | | loose |
| | CL<br>FILL | **SILTY CLAY, FILL**<br>with some fine sand; brown | | 11 | | 11.2 | 110 | | | | moist<br>medium stiff |
| | CL | **FINE SANDY CLAY**<br>with some silt; brown | 10 | 29 | | | | | | | moist<br>stiff |
| ▼ | SP/<br>SM | **FINE SAND**<br>with some silt; brown | 15 | 12 | | | | | | | moist<br>medium dense<br>loose |
| | | | 20 | 3 | | 23.3 | | 10.1 | | | saturated<br>very loose |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

# BORING LOG



**BORING: B-2**

**CLIENT:** VCBO Architecture **PROJECT NUMBER:** 0068-015-12

**PROJECT:** Stromberg Athletic Complex Addition **DATE STARTED:** 5-4-12

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 25 | | | | | | | | |
| | | | | 10 | | 23.0 | | 12.6 | | | medium dense |
| | | | 30 | | | | | | | | |
| | | grades with trace medium to coarse sand and trace fine and coarse gravel | | 15 | | 20.7 | | 10.6 | | | |
| | | Stopped drilling at 30.0'.<br>Installed 1-1/4'' diameter slotted PVC pipe to 30.0'. | 35 | | | | | | | | |
| | | | 40 | | | | | | | | |
| | | | 45 | | | | | | | | |
| | | | 50 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3B
(cont'd)

# GSH

# BORING LOG



## BORING: B-3

**CLIENT:** VCBO Architecture
**PROJECT NUMBER:** 0068-015-12
**PROJECT:** Stromberg Athletic Complex Addition
**DATE STARTED:** 5-4-12
**LOCATION:** Weber State University Campus, Ogden, Utah
**DATE FINISHED:** 5-4-12
**GSH Field Rep.:** HRW
**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger
**HAMMER:** Automatic
**WEIGHT:** 140 lbs
**DROP:** 30"
**GROUNDWATER DEPTH:** 20' (5/4/12) 21' 8" (5/9/12) 21' 7" (5/17/12)
**ELEVATION:** ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | 0 | | | | | | | | |
| | | **3.5" ASPHALT ON 8.0" BASE** | | | | | | | | | |
| | CL FILL | **SILTY CLAY, FILL** with some fine sand; dark brown | | 38 | | | | | | | moist very stiff |
| | SM FILL | **SILTY FINE SAND, FILL** with some clay pieces; brown | 5 | 50 | | | | | | | moist medium dense |
| | SM | **SILTY FINE TO MEDIUM SAND** brown | | 15 | | | | | | | moist loose |
| | | | 10 | 12 | | | | | | | |
| | | grades with trace medium to coarse sand and trace fine gravel | 15 | 21 | | | | | | | |
| | SP | **FINE TO MEDIUM SAND** with trace silt; brown | 20 | 18 | | 11.8 | | 5.2 | | | moist medium dense |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

# BORING LOG



**BORING: B-3**

**CLIENT:** VCBO Architecture **PROJECT NUMBER:** 0068-015-12

**PROJECT:** Stromberg Athletic Complex Addition **DATE STARTED:** 5-4-12

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | grades with some medium sand and trace coarse sand | 25 | 22 | | | | | | | saturated |
| | | medium to coarse sand grades out | 30 | 26 | | | | | | | |
| | | Stopped drilling at 30.0'.<br>Installed 1-1/4'' diameter slotted PVC pipe to 30.0'. | 35<br>40<br>45<br>50 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3C
(cont'd)

# GSH

# BORING LOG



## BORING: B-4

**CLIENT:** VCBO Architecture
**PROJECT NUMBER:** 0068-015-12
**PROJECT:** Stromberg Athletic Complex Addition
**DATE STARTED:** 5-4-12
**LOCATION:** Weber State University Campus, Ogden, Utah
**DATE FINISHED:** 5-4-12
**GSH Field Rep.:** HRW
**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger
**HAMMER:** Automatic
**WEIGHT:** 140 lbs
**DROP:** 30"
**GROUNDWATER DEPTH:** 19.5' (5/4/12)
**ELEVATION:** ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | 0 | | | | | | | | |
| | | **2.5" ASPHALT ON 9.0" BASE** | | | | | | | | | |
| | CL FILL | **SILTY CLAY, FILL** with some fine to coarse sand; dark gray/brown | | 12 | | | | | | | |
| | | sampler on rock | 5 | | | | | | | | |
| | | grades with some fine sand and trace medium to coarse sand and coarse gravel; brown | | 70 | | | | | | | |
| | SP/ SM | **FINE SAND** with trace to some silt; brown | | 17 | | | | | | | moist |
| | | | 10 | 27 | | | | | | | |
| | | | 15 | 36 | | | | | | | |
| ▼ | | | | | | | | | | | saturated |
| | | | 20 | 5 | | 24.2 | | 5.5 | | | |
| | SP | **FINE SAND** with trace silt; brown | | | | | | | | | saturated medium dense |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

# BORING LOG



**BORING: B-4**

**CLIENT:** VCBO Architecture **PROJECT NUMBER:** 0068-015-12

**PROJECT:** Stromberg Athletic Complex Addition **DATE STARTED:** 5-4-12

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 25 | 12 | | 25.6 | | 1.8 | | | |
| | SM | **SILTY FINE SAND**<br>brown | 30 | 5 | | 22.7 | | 18.0 | | | saturated<br>loose |
| | | Stopped drilling at 30.0'.<br>Installed 1-1/4'' diameter slotted PVC pipe to 30.0'. | 35<br>40<br>45<br>50 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3D
(cont'd)

**PROJECT:** Stromberg Athletic Complex Addtion
**PROJECT LOCATION:** Weber State University Campus, Ogden, Utah
**PROJECT NUMBER:** 0068-015-12

# KEY TO BORING LOG

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

## COLUMN DESCRIPTIONS

1. **Water Level**: Depth to measure groundwater table. See symbol below.
2. **USCS**: Graphic depiction of subsurface material encountered; typical symbols are explaned below.
3. **Description**: Description of material encountered; may include color, moisture, grain size, and density/consistency.
4. **Depth (ft.)**: Depth in feet below the ground surface.
5. **Blow Count**: Number of blows required to advance sampler (12 inches) beyond first. using a 140-lb hammer with a 30 inch drop.
6. **Sample Symbol**: Type of soil sample collected at depth interval shown; sampler symbols are explained below.
7. **Moisture (%)**: Water content of soil sample measured in laboratory; expressed as percentage of dry weight of specimen.
8. **Dry Density (pcf)**: The density of a soil measured in laboratory; expressed as pounds per cubic foot.
9. **% Passing 200:** Fines content of soil sample passing a No. 200 sieve measured in laboratory, expressed as a percentage.
10. **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.
11. **Placsticity Index (%):** Range of water content at which a soil exhibits plastic properties.
12. **Remarks**: Comments and observations regarding drilling or sampling made by driller or field personnel. Other field and laboratory test results; using the following abbreviations:

**CEMENTATION**

**Weakly:** Crumbles or breaks with handling of slight finger pressure.
**Moderately:** Crumbles or breaks with considerable finger pressure.
**Strongly:** Will not crumble or break with finger pressure.

**MODIFIERS**

**Trace** <5 %
**Some** 5 - 12%
**With** >12%

**MOISTURE CONTENT (FIELD TEST)**

**Dry:** Absence of moisture, dusty, dry to the touch.
**Moist:** Damp but no visible water.
**Saturated:** Visible water, usually soil below water table.

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the 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.

UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | | SYMBOLS Graph | SYMBOLS Letter | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE-GRAINED SOILS<br>More than 50% of No. 200 sieve size. | GRAVELS<br>More than 50% of coarse fraction retained in No. 4 sieve. | CLEAN GRAVELS (little or no fines) | | GW | Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines |
| | | | | GP | Poorly-Graded Gravel, Gravel-Sand Mixtures, Little or No Fines |
| | | GRAVELS WITH FINES (appreciable amount of fines) | | GM | Silty Gravels, Gravel-Sand-Silt Mixtures |
| | | | | GC | Clayey Gravels, Gravel-Sand-Clay Mixtures |
| | SANDS<br>More than 50% of coarse fraction passing through No. 4 sieve. | CLEAN SANDS (little or no fines) | | SW | Well-Graded Sands, Gravelly Sands, Little or No Fines |
| | | | | SP | Poorly Graded Sands, Gravelly Sands, Little or No Fines |
| | | SANDS WITH FINES (appreciable amount of fines) | | SM | Silty Sands, Sand-Clay Mixtures |
| | | | | SC | Clayey Sands, Sand-Clay Mixtures |
| FINE-GRAINED SOILS<br>More than 50% of material is smaller than No. 200 sieve size. | SILTS AND CLAYS<br>Liquid limit less than 50% | | | ML | Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity |
| | | | | CL | Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays |
| | | | | OL | Organic Silts and Organic Silty Clays of Low Plasticity |
| | SILTS AND CLAYS<br>Liquid limit greater than 50% | | | MH | Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils |
| | | | | CH | Inorganic Clays of High Plasticity, Fat Clays |
| | | | | OH | Organic Clays of Medium to High Plasticity, Organic Silts |
| HIGHLY ORGANIC SOILS | | | | PT | Peat, Humus, Swamp Soils with High Organic Contents |

Note: Dual Symbols are used to indicate borderline soil classifications

**STRATIFACTION**

| DESCRIPTION | THICKNESS |
|---|---|
| Seam | up to 1/8" |
| Layer | 1/8" - 12" |

**STRATIFACTION**

**Occasional:** One or less per 6" of thickness.
**Numerous:** More than one per 6" of thickness.

**TYPICAL SAMPLER GRAPHIC SYMBOLS**

- Bulk/Bag Sample
- Standard Penetration Split Spoon Sampler
- Rock Core
- No Recovery
- 3-3/4" ID D&M Sampler
- 3" ID D&M Sampler
- California Sampler
- Thin Wall

**LOG KEY SYMBOLS**

- Water Level

FIGURE 4

GSH

# GENERAL CONDITIONS

May 25, 2005

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# GENERAL CONDITIONS

May 25, 2005

## ARTICLE 1. GENERAL PROVISIONS.

### 1.1 BASIC DEFINITIONS.

**A/E** (including all design professionals). "A/E" means the person lawfully licensed to practice architecture or engineering or an entity lawfully practicing architecture or engineering identified as such in the A/E's Agreement and is referred to throughout the Contract Documents as if singular in number. The term "A/E" also means the A/E's representative and its subconsultants. When these General Conditions are part of a Contract in which the design professional is an interior designer, landscape subconsultant or other design professional, the term "A/E" as used in these General Conditions shall be deemed to refer to such design professional. A license is not required when the type of design professional is one which is not subject to a professional license, but such professional must meet the prevailing standards in the State of Utah for such practice. For projects where there is no A/E hired by DFCM, the references in the General Conditions to A/E shall be deemed to refer to DFCM as may be practicably applied.

**ADDENDA**. "Addenda" means the written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

**ASI.** "ASI" shall mean a Supplemental Instruction issued by the A/E to the Contractor which may result in clarifications or minor changes in the Work and does not affect the contract time or the contract amount.

**BID**. "Bid" means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

**BONDS.** "Bonds" mean the bid bond, performance and payment bonds and other instruments of security.

**CHANGE ORDER**. "Change Order" means a written instrument signed by the DFCM and Contractor, stating their agreement for changes of the Contract as specified on the required DFCM's change order form.

**CLAIM.** "Claim" means a dispute, demand, assertion or other matter submitted by the Contractor, including a Subcontractor at any tier subject to the provisions of these General Conditions. The claimant may seek, as a matter of right, modification, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. A request for Preliminary Resolution Effort (PRE) shall not be considered a "Claim." A requested amendment, requested change order, or a Construction Change Directive (CCD) is not a PRE or Claim unless agreement cannot be reached and the procedures of these General Conditions are followed.

**CONSTRUCTION CHANGE DIRECTIVE**. A "Construction Change Directive" means a written order signed by the DFCM, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The DFCM may by Construction Change Directive, without

invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions; even if it may impact the Contract Sum and Contract Time.

**CONTRACT**. The Contract Documents form the Contract for Construction. The term "Contract" represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the A/E and Contractor, (2) between the DFCM and a Subcontractor or (3) between any persons or entities other than the DFCM and Contractor.

**CONTRACT DOCUMENTS**. The term "Contract Documents" means the Contractor's Agreement between the DFCM and Contractor (hereinafter referred to as "Contractor's Agreement"), the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, Specifications, Addenda, other documents listed in the Contractor's Agreement and Modifications issued after execution of the Contractor's Agreement. The Contract Documents shall also include the bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form, to the extent not in conflict with the other above-stated Contract Documents and other documents and oral presentations as part of the Selection which are documented as an attachment to the Contract.

**CONTRACT SUM**. The term "Contract Sum" means the Contract Sum as stated in the Contractor's Agreement and, including authorized and signed adjustments to this agreement (modifications), is the total amount payable by the DFCM to the Contractor for performance of the Work under the Contract Documents.

**CONTRACT TIME**. "Contract Time", unless otherwise provided in the Contract Documents, means the period of time, including authorized and signed adjustments (modifications), stated in the Contract Documents for Substantial Completion of the Work.

**CONTRACTOR**. The Contractor is the person or entity identified as such in the DFCM Contractor's Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative. When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case, shall mean the Contractor who executes each separate DFCM Contractor Agreement.

**CONTRACTOR'S AGREEMENT.**
"Contractor's Agreement" means, unless the context requires otherwise, the agreement executed by the Contractor and DFCM for the Project.

**DAY**. The term "day" or "days" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

**DEFECTIVE**. "Defective" is an adjective which when modifying the word "Work" refers to Work that does not conform to the Contract Documents, or does not meet the requirements of any inspection, referenced standard, code, test or approval referred to in the Contract Documents, or has been damaged.

**DFCM REPRESENTATIVE**.
"DFCM Representative" means the Division of Facilities Construction and Management person directly assigned to work with the Contractor on a regular basis. Unless the context requires otherwise, the "DFCM Representative" is the "Owner's Representative."

**DIRECTOR**. "Director" means the Director of the Division of Facilities Construction and Management unless the context requires otherwise. Director may include a designee selected by the Director for the particular function referred to in the General Conditions.

**DFCM.** "DFCM" means the Division of Facilities Construction and Management established pursuant to Utah Code Annotated Section 63A-5-201 et seq. Unless the context requires otherwise, DFCM is the "Owner" as that term is commonly referred to in the construction industry.

**DRAWINGS**. The "Drawings" are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, and generally include the drawings, elevations, sections, details, schedules and diagrams.

**EXECUTIVE DIRECTOR.**
"Executive Director" means the Executive Director of the Department of Administrative Services, including unless otherwise stated, his/her duly authorized designee.

**INSPECTION**. The word "inspection" or its derivatives shall mean a review of the Project, including but not limited to a visual review of the Work completed to date to ascertain if the Work is in accordance with the Contract Documents, including all applicable building codes and construction standards.

**MODIFICATION**. A "Modification" is (1) a Change Order (2) Construction Change Directive or (3) ASI. The Contract may be amended or modified only by (1) a written amendment executed by both the DFCM and Contractor, or (2) by a Modification.

**NOTICE TO PROCEED**. A "Notice to Proceed" is a document prepared by the–DFCM and by its terms authorizes the Contractor to commence Work on the Project. It is deemed issued upon being sent by the DFCM to the Contractor's specified address within the bid or proposal.

**PARTIAL USE**. "Partial Use" means placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work. This partial use does not constitute "substantial completion".

**PRELIMINARY RESOLUTION EFFORT**. "Preliminary Resolution Effort" or "PRE" means the processing of a request for preliminary resolution or any similar notice about a problem that could potentially lead to a Claim and is prior to reaching the status of a Claim.

**PRODUCT DATA**. "Product Data" means illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**PROJECT.** The "Project" means the total construction of the Work performed under the Contract Documents.

**PROJECT MANUAL (FOR CONSTRUCTION)**. The "Project Manual" is the volume assembled for the Work and may include the bidding/proposal requirements, sample forms, General or Supplementary Conditions of the Contract and Specifications.

**PROPOSAL REQUEST OR "PR."**
A "Proposal Request" or "PR" is a proposal request filed with the Contractor for the purposes of seeking a proposal in order to resolve an issue as part of the Change Order or Contract Modification process.

**PROPOSED CHANGE ORDER.** A "Proposed Change Order" ("PCO"), is an informal request by the Contractor filed with the DFCM Representative, in an effort to commence the Contract Modification Process. It shall not be considered a "PRE" or a "Claim." The PCO may be related to any potential, or actual delay, disruption, unforeseen condition or materials or any other matter in which the Contractor intends to seek additional monies or time.

**REQUEST FOR INFORMATION or RFI.** A "Request for Information" or "RFI" is a request filed by the Contractor with the A/E regarding any request for information, direction or clarification related to the Contract Documents, plans or specifications.

**RESOLUTION OF THE CLAIM.** "Resolution of the Claim" means the final resolution of the Claim by the Director, but does not include any administrative appeal, judicial review or judicial appeal thereafter.

**RULE.** "Rule," unless the context requires otherwise, shall mean a Rule of the Utah Administrative Code.

**SALES TAX and/or USE TAX**. Sales Tax and/or Use Tax, unless the context requires otherwise, shall mean the sales tax and/or use tax collected or to be collected by the Utah State Tax Commission and shall include any sales and/or use tax that the Utah State Tax Commission collects on behalf of any special district, local government or political subdivision.

**SAMPLES**. "Samples" mean physical examples, which illustrate materials, equipment or workmanship and establishes standards by which the Work will be judged.

**SHOP DRAWINGS**. "Shop Drawings" means drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

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

**SUBCONTRACTOR**. "Subcontractor" means the person or entity that has a direct contract with the Contractor, including any trade contractor or specialty contractor, or with another Subcontractor at any tier to provide labor or materials for the work but does not include suppliers who provide only materials, equipment or supplies to a contractor or subcontractor. Notwithstanding the foregoing, the text in which the term is used may provide for the exclusion of Subcontractors of other Subcontractors or the exclusion of suppliers. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or authorized representative of the Subcontractor. The Term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

**SUBSTANTIAL COMPLETION**. "Substantial Completion" is the date certified in accordance with Article 9.2 and means the date the Work or designated portion thereof is sufficiently complete, and any lack of completion or performance does not reasonably interfere with the DFCM's intended use of the Project, in accordance with the Contract Documents so that the DFCM can occupy and use the Work for its intended use. DFCM's "intended use" or "occupy" as used in this definition, shall include any intended use or occupation by any agency or entity for which DFCM has intended to so occupy the Project.

**SUPPLEMENTARY CONDITIONS OR SUPPLEMENTARY GENERAL CONDITIONS**. "Supplementary Conditions" or "Supplementary General Conditions" means the part of the Contract Documents which amends or supplements these General Conditions.

**WORK**. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all labor, materials, equipment and services provided, or to be provided, by the Contractor to fulfill the Contractor's obligations.

## ARTICLE 2. DFCM.

### 2.1 INFORMATION AND SERVICES REQUIRED OF THE DFCM.

**2.1.1 DFCM'S REPRESENTATIVE**. The DFCM shall designate a DFCM Representative authorized to act in the DFCM's behalf with respect to the Project. The DFCM or such authorized representative shall render decisions within a reasonable time pertaining to documents submitted by the A/E and/or Contractor in order to avoid a compensable delay in the orderly and sequential progress of the Project.

**2.1.2 SPECIALISTS AND INSPECTORS**. The DFCM will provide certified building inspection services in accordance with the adopted Building Codes. This includes 'routine' and 'special' inspections unless otherwise noted in the A/E Agreement. The DFCM may assign an inspector or specialist to note deviations from, or necessary adjustments to, the Contract Documents or to report deficiencies or defects in the Work. The inspector or specialist's activities in no way relieves the

Contractor of the responsibilities set forth in the Contract Documents.

**2.1.3 SURVEYS AND LEGAL DESCRIPTION**. The DFCM shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall review this information, including the surveys and any provided soils tests, and compare such information with observable physical conditions and the Contract Documents.

**2.1.4 PROMPT INFORMATION AND SERVICES**. Upon receipt of a written request from the Contractor, the DFCM shall furnish information or services under the DFCM's control with reasonable promptness to avoid delay in the orderly progress of the Work.

**2.1.5 COPIES OF DRAWINGS AND PROJECT MANUALS (FOR CONSTRUCTION)**. Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals (for construction) as are reasonably necessary for execution of the Work. DFCM's Web Page may also provide referenced documents for the Project.

**2.1.6 OTHER DUTIES**. The foregoing is in addition to other duties and responsibilities of the DFCM enumerated herein and especially those in respect to Article 2.2 (Construction by DFCM or by Separate Contractors), Article 8 (Payments and Completion) and Article 10 (Insurance and Bonds).

**2.2 CONSTRUCTION BY DFCM OR BY SEPARATE CONTRACTORS**

**2.2.1 DFCM'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS**.

(1) **IN GENERAL**. The DFCM reserves the right to perform construction or operations related to the Project with the DFCM's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation.

(2) **COORDINATION AND REVISIONS**. The DFCM shall provide for coordination of the activities of the DFCM's own forces and of each separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the DFCM in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule and Contract Sum deemed necessary after a joint review and agreement by the DFCM. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the DFCM until subsequently revised.

**2.2.2 MUTUAL RESPONSIBILITY**.

(1) **CONTRACTOR COORDINATION**. The Contractor shall afford the DFCM and separate contractor(s) a reasonable opportunity for delivery and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

(2) **REPORTING PROBLEMS TO DFCM**. If part of the Contractor's Work depends on work by the DFCM or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report in writing to the DFCM apparent defects in workmanship that would render it unsuitable for proper execution. Failure of the Contractor to make said report shall constitute an acknowledgment that the DFCM's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects in workmanship not then reasonably discoverable.

(3) **COSTS**. Costs caused by delays or by improperly timed activities or defective construction shall be borne by the responsible party in accordance with the procedures and provisions of the Contract Documents.

(4) **CONTRACTOR REMEDIAL WORK**. The Contractor shall promptly remedy damage caused by the Contractor to completed or partially completed Work or to property of the DFCM or separate contractors and subcontractors as provided in Article 6.

## ARTICLE 3. A/E.

### 3.1 A/E'S ADMINISTRATION OF THE CONTRACT.

**3.1.1 IN GENERAL**. The A/E assists the DFCM with the administration of the Contract as described in the Contract Documents. The A/E shall have the authority to act on behalf of the DFCM only to the extent provided in the Contract Documents or A/E's Agreement.

**3.1.2 SITE VISITS**.

(1) Site visits or inspections by the A/E, the DFCM or any DFCM representative shall in no way limit or affect the Contractor's responsibility to comply with all the requirements and the overall design concept of the Contract Documents as well as all applicable laws, statutes, ordinances, resolutions, codes, rules, regulations, orders and decrees.

(2) **WRITTEN REPORT.** The A/E shall promptly submit to the DFCM a written report subsequent to each site visit.

**3.1.3 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION**. Except as authorized by the DFCM Representative or as otherwise provided in the Contract Documents, including these General Conditions, the A/E and Contractor shall communicate through the DFCM Representative on issues regarding the timing of the Work, cost of the Work or scope of the Work. Contractor shall comply with communication policies agreed upon at any pre-construction meeting with the DFCM. Communications by and with the A/E subconsultants shall be through the A/E. Communications by and with Subcontractors shall be through the Contractor. Communications by and with separate contractors shall be through the DFCM.

**3.1.4 A/E MAY REJECT WORK, ORDER INSPECTION, TESTS**. The A/E shall have the responsibility and authority to reject Work which, based upon the A/E's knowledge or what may be reasonably inferred from the A/E's site observations and review of data, does not conform to the Contract Documents. Whenever the A/E considers it necessary or advisable for implementation of the intent of the Contract Documents, the A/E shall have the responsibility and authority to require additional inspections or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed or completed, provided, however, the A/E must obtain the DFCM's prior written approval of any such additional inspections or testing. However, neither this authority of the A/E nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the A/E to the Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work, including separate contractors. If the Contractor disputes the rejection of any Work and the correction thereof shall involve additional cost or time, it shall be the DFCM's option to accept such Work whether it be conforming or nonconforming.

**3.1.5 A/E REVIEW CONTRACTOR'S SUBMITTALS.**

(1) Contractor shall submit shop drawings, product data, and samples and other submittals required by the Contract Documents to the A/E as required by the approved submittal schedule.

(2) The A/E shall review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the purpose of checking for conformance with the information and design concepts expressed in the Contract Documents. A/E action taken on a submittal shall not constitute a Modification of this Agreement.

(3) The A/E's action shall be taken no later than 15 days following A/E's receipt of the submittal, unless agreed to otherwise by Contractor and DFCM, in order to avoid a delay in the Work of the Contractor or of separate contractors while allowing sufficient time in the A/E's professional judgment to permit adequate review.

(4) Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents.

(5) The A/E's review of the Contractor's submittals shall not relieve the Contractor of the obligations under the Contract Documents.

(6) The A/E's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the A/E, of any construction means, methods, techniques, sequences or procedures.

(7) The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

(8) When professional certification of performance characteristics of materials, systems or equipment is required by the Contract Documents, the A/E shall be entitled to rely upon such certifications to establish that the materials systems or equipment will meet the performance criteria required by the Contract Documents.

**3.2 OWNERSHIP AND USE OF A/E'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS**. All Drawings, Specifications and other documents prepared by the A/E are and shall remain the property of the DFCM, and DFCM shall retain all common law, statutory and other reserved rights with respect thereto. Said documents were prepared and are intended for use as an integrated set for the Project which is the subject of this Contractor's Agreement. The Contractor shall not modify or use Contract Documents on any other project without the prior written consent of the DFCM and A/E. Any such non-permissive use or modification, by Contractor, the Contractor's Subcontractors at any tier or anyone for whose acts the Contractor is liable, shall be at Contractor's sole risk. Contractor shall hold harmless and indemnify the DFCM from and against any and all claims, actions, suits, costs, damages, loss, expenses and attorney fees arising out of such non-permissive use or modification by the Contractor. The Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the A/E appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the A/E. Submittals or distributions necessary to meet official regulatory requirements or for other purposes relating to completion of the Project are not to be construed as a publication in derogation of the DFCM's copyright or other reserved rights.

## ARTICLE 4. CONTRACTOR

### 4.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR.

**4.1.1 REVIEWING CONTRACT DOCUMENTS, INFORMATION, REPORTING ERRORS, INCONSISTENCIES OR OMISSIONS**. The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the DFCM pursuant to Article 2.1 hereinabove and shall at once report to the DFCM and A/E errors, inconsistencies or omissions discovered. The Contractor shall not be liable to the DFCM or A/E for damage resulting from errors, inconsistencies or omission in the Contract Documents, unless the Contractor recognized such error, inconsistency or omission or a Contractor of ordinary skill and expertise for the type of Work involved would have readily so recognized such error, inconsistency or omission, and the Contractor

failed to report such to the DFCM and A/E. If the Contractor performs any construction activity without such notice to the DFCM and A/E and prior to the resolution of the error, inconsistency or omission, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**4.1.2 FIELD CONDITIONS**. The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor, or information which a Contractor of ordinary skill and expertise for the type of Work involved would have known, before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the DFCM and A/E at once. If the Contractor performs any construction activity without such notice to the DFCM and A/E and prior to the resolution of the error, inconsistency or omission, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**4.1.3 PERFORM IN ACCORDANCE WITH CONTRACT DOCUMENTS AND SUBMITTALS**. The Contractor shall perform the Work in accordance with the Contract Documents and submittals approved in accordance with the Contract Documents

**4.1.4 PERFORMANCE TO PRODUCE THE COMPLETE SYSTEM AND INTENDED RESULTS.** Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from the Contract Documents as being necessary to allow the system to function within its intended use.

**4.1.5 INTENT AND HIERARCHY**. The Contract Documents should be read as a whole and wherever possible, the provisions should be construed in order that all provisions are operable. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one Document or provisions thereof shall be as binding as if required by all the Documents or provisions thereof. In case of an irreconcilable conflict between provisions within a Contract Document or between Contract Documents, the following priorities shall govern as listed below:

(1) A particular Modification shall govern over all Contract Document provisions or Modifications issued prior to said particular Modification.

(2) Attachments to the Contractor's Agreement resulting from the Selection process including any management plan or documented interview information shall govern over addenda, the General Conditions, plans and specifications**.**

(3) A particular Addendum shall govern over all other Contract Document provisions issued prior to said particular Addendum. Subsequent Addenda shall govern over all prior Addenda.

(4) The Supplementary General Conditions shall govern over the General Conditions.

(5) These General Conditions shall govern over all other Contract Documents except for the Supplementary General Conditions, Addenda, Modifications and Attachments resulting from the selection process.

(6) The drawings and specifications shall not govern over any of the documents listed above.

(7) In case of a conflict or ambiguity within the same level of hierarchy of described documents, DFCM reserves the right to select the most stringent requirement unless the preponderance of the contract indicates the less stringent requirement.

**4.1.6 DIVIDING WORK AND CONTRACTOR REPRESENTATION**. Organization of the specifications into divisions, sections and articles, and arrangement of Drawings, shall not control the Contractor in

dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Contractor represents that the Subcontractors, Sub-subcontractors, manufacturers and suppliers engaged or to be engaged by it are and will be familiar with the requirements for performance by them of their obligations.

**4.1.7 PLANNING AND PRIORITY**. The Contractor shall plan and schedule its work to facilitate the Project and shall maintain a work schedule to place proper priority to sequence work to complete the project timely.

**4.2 SUPERVISION AND CONSTRUCTION PROCEDURES**.

**4.2.1 SUPERVISION AND CONTROL**. The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over the construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, except to the extent that the Contract Documents expressly and specifically state otherwise.

**4.2.2 RESPONSIBILITY**. The Contractor shall be responsible to the State of Utah and DFCM for acts and omissions of the Contractor's employees, Subcontractors, and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor or on behalf of the Contractor.

**4.2.3 NOT RELIEVED OF OBLIGATIONS**. The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the DFCM or its agents in the DFCM's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor or for those that the Contractor is liable.

**4.2.4 INSPECTIONS AND APPROVALS**.

(1) The Contractor is responsible for requesting inspections for various stages and portions of the Work required under the Contract Documents in a timely manner.

(2) If any of the Work is required to be inspected or approved by the terms of the Contract Documents by any public authority, the Contractor shall timely request such inspection or approval to be performed in accordance with Article 9. Except as provided in Article 9, work shall not proceed without any required inspection and the associated authorization to proceed. Contractor shall promptly notify DFCM if the inspector fails to appear at the site.

**4.3 LABOR AND MATERIALS**.

**4.3.1 PAYMENT BY CONTRACTOR**. Except to the extent it is otherwise stated in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipments, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities, supplies, consumables and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**4.3.2 DISCIPLINE AND COMPETENCE**. The Contractor shall enforce strict discipline and good order among the Contractor's employees, its Subcontractors, agents, representatives and other persons performing under the Contract Documents. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

**4.4 TAXES AND OTHER PAYMENTS TO GOVERNMENT**. The Contractor shall pay sales, consumer, use, employment-related and similar taxes related to the Work or portions thereof provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. The Contractor shall comply with the laws and regulations regarding the payment of Sales and/or Use Tax and any exemptions. The procurement documents may have a provision regarding specific items which are exempt from State of Utah Sales Tax and/or Use Tax. Any such

exemption shall be used only for the items and the project specified in the procurement documents. Any such exemption does not apply to taxes levied by the federal government or any taxing entity outside of the State of Utah. If a Contractor properly relies upon a provision(s) of the bidding or proposal documents, and if State of Utah Sales and/or Use Tax subsequently becomes due, then the Contractor shall be paid such tax amount not included in the bid/proposal amount due to the reliance upon such provision.

**4.5 PERMITS, FEES, NOTICES, LABOR AND MATERIALS**.

**4.5.1 PERMITS AND FEES**. Unless required in the Supplementary General Conditions or an Addendum, it will not be necessary for the Contractor to obtain or pay for local building permits, plan check fees, electrical permits, plumbing permits, connection fees, or impact fees, nor will it be necessary to pay fees for inspections pertaining thereto.

**4.5.2 COMPLIANCE WITH PUBLIC AUTHORITIES, NOTICES**. The Contractor shall comply with and give notices required by laws, ordinances, resolutions, rules, regulations and lawful orders of public authorities bearing on the performance of the Work.

**4.5.3 CORRELATION OF CONTRACT DOCUMENTS AND ENACTMENTS**. It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, resolutions, building codes, and rules and regulations. Notwithstanding this, if the Contractor observes, or if such is readily observable to a Contractor of ordinary skill and expertise for the type of Work involved, that a portion of the Contract Documents is at variance therewith, the Contractor shall promptly notify the A/E and DFCM in writing, and necessary changes shall be accomplished by appropriate Modification.

**4.5.4 FAILURE TO GIVE NOTICE**. If the Contractor, or any Subcontractor thereof performs Work without complying with the requirements of this Article 4.5 hereinabove, the Contractor shall assume appropriate responsibility for such Work and shall bear the appropriate amount of the attributable costs.

**4.6 SUPERINTENDENT**. The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

**4.7 TIME AND CONTRACTOR'S CONSTRUCTION SCHEDULES**.

**4.7.1 PROGRESS AND COMPLETION**.

(1) **TIME IS OF THE ESSENCE; COMPLETE WITHIN CONTRACT TIME**. Time is of the essence. By executing the Contractor's Agreement, the Contractor confirms that the Contract Time is adequate to perform the Work. The Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time.

(2) **NOTICE TO PROCEED AND INSURANCE**. The Contractor shall not prematurely commence operations on the site or elsewhere prior to the issuance of a Notice to Proceed by the DFCM or prior to the effective date of insurance required by Article 10 to be furnished by the Contractor, whichever is the latter.

**4.7.2 SCHEDULE PREPARATION**. The Contractor, promptly after being awarded the Contract, shall prepare and submit for the DFCM's and A/E's review, a reasonably detailed CPM schedule for the Work. The schedule shall indicate the order, sequence, and interdependence of all items known to be necessary to complete the Work including construction, procurement, fabrication, and delivery of materials and equipment, submittals and approvals of samples, shop drawings, procedures, or other documents. Work items of the DFCM, other Contractors, utilities and other third parties that may affect or

be affected by the Contractor shall be included. If the DFCM is required, by the Contract Documents, to furnish any materials, equipment, or the like, to be incorporated into the Work by the Contractor, Contractor shall submit, with the first schedule submittal, a letter clearly indicating the dates that such items are required at the Project Site. The critical path should be identified, including the critical paths for interim completion dates and milestones. The CPM schedule shall be developed using Primavera, MS Project, or Suretrack unless otherwise authorized by the DFCM Representative. The Contractor's schedule shall be updated at least once a month and submitted with each pay request.

**4.7.3 INITIAL CONTRACT TIME**. Unless otherwise specified in the bidding documents, the initial Contract Time is the time identified in the Contractor's Agreement.

**4.7.4 INTERIM COMPLETION DATES AND MILESTONES**. The schedule must include contractually specified interim completion dates and milestones. The milestone completion dates indicated are considered essential to the satisfactory performance of this Contract and to the coordination of all Work on the Project. The milestone dates listed are not intended to be a complete listing of all Work under this Contract or of interfaces with other Project Contractors.

**4.7.5 SCHEDULE CONTENT REQUIREMENTS**. The schedule shall indicate an early completion date for the Project that is no later than the Project's required completion date. The schedule, including all activity duration's shall be given in calendar days. The Schedule shall also indicate all of the following:

(1) Interfaces with the work of outside contractors (e.g., utilities, power and with any separate Contractor);

(2) Description of activity including activity number/numbers;

(3) Estimated duration time for each activity;

(4) Early start, late start, early finish, late finish date, and predecessor/successors including stop-start relationships with lead and lag time for each activity;

(5) Float available to each path of activities;

(6) Actual start date for each activity begun;

(7) Actual finish date for each activity completed;

(8) The percentage complete of each activity in progress or completed;

(9) Identification of all critical path activities;

(10) The critical path for the Project, with said path of activities being clearly and easily recognizable on the time-scaled network diagram. The path(s) with the least amount of float must be identified. Unless otherwise authorized by the DFCM Representative, no more than 40% of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path shall be clearly shown on the network diagram;

(11) Unless otherwise authorized by the DFCM Representative, all activities on the schedule representing construction on the site may not have a duration longer than 14 days. Construction items that require more than 14 days to complete must be broken into identifiable activities on the schedule with durations less than 14 days. The sum of these activities represents the total length required to complete that construction item; and

(12) Additional requirements as specified in the Supplemental General Conditions.

**4.7.6 DFCM'S RIGHT TO TAKE EXCEPTIONS**. The DFCM reserves the right to take reasonable exception to activity duration, activity placement, construction logic or time frame for any element of the Work to be scheduled.

**4.7.7 FLOAT TIME**. Float or slack time is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date of a chain of activities on the Schedule. By a proposal request or modification delivered to the Contractor, the DFCM has the right to use the float time for non-critical path activities until the Contractor has reallocated such time on a newly submitted schedule.

**4.7.8 INITIAL SCHEDULE SUBMISSION**. No progress payments will be approved until the Contractor has submitted a Project detailed CPM schedule covering the first 90 days of the Work with a general CPM schedule for the entire project. The detailed schedule for the entire project is to be completed prior to the second pay request unless otherwise authorized in writing by the DFCM Representative.

**4.7.9 UPDATES**. Prior to any approval of a pay request, the DFCM, A/E and Contractor shall review the Contractor's schedule compared to the Work completed. The DFCM approves the amount of Work completed as supported by the schedule of values and as verified by the determination of Work completed. If necessary, the Contractor shall then update and submit to the DFCM the schedule with the pay request; all of which in accordance with the DFCM's approval. All updates shall be provided in electronic and hard copy formats. At each scheduled meeting with the DFCM Representative, the Contractor shall provide a "three week look ahead" with long lead items identified.

**4.7.10 SCHEDULE OF SUBMITTALS**. The Contractor shall prepare and keep current, for the A/E's and DFCM's review, a schedule of submittals required under the Contract Documents which is coordinated with the Contractor's construction schedule and allows the A/E a reasonable time to review the submittals. This submittal schedule is to be included as part of the construction schedule. Submittals requiring expedited review must be clearly identified as such in the schedule of submittals.

**4.7.11 SCHEDULE RECOVERY**. If the Work represented by the critical path falls behind more than 7 days, the project schedule shall be redone within 14 days showing how the Contractor shall recover the time. A narrative that addresses the changes in the schedule from the previously submitted schedule shall be submitted along with the schedule in both hard copy (appropriate report formats to be determined by the–DFCM Representative) and electronic copy. The Contractor shall comply with the most recent schedules.

**4.7.12 SCHEDULE CHANGES AND MODIFICATIONS**.

(1) **CONTRACT TIME CHANGE REQUIRES MODIFICATION**. The Contract Time may only be shortened or extended by a written modification fully executed by the DFCM.

(2) **CONTRACTOR REORDERING, RESEQUENCING AND CHANGING ACTIVITY DURATIONS.** Should the Contractor, after approval of the complete detailed construction schedule, desire to change his plan of construction, he shall submit his requested revisions to the DFCM and the A/E along with a written statement of the revisions including a description of the sequence and duration changes for rescheduling the work, methods of maintaining adherence to intermediate milestones and the contract completion date and the reasons for the revisions. If the requested changes are acceptable to the DFCM, which acceptance shall not be unreasonably withheld, they will be incorporated into the Schedule in the next reporting period. If after submitting a request for change in the Contract Schedule, the DFCM does not agree with the request, the DFCM will schedule a meeting with the Contractor to discuss the differences.

(3) **CHANGES IN CONTRACT TIME**. The critical path schedule as the term is used in the provisions herein shall be based on the current version of the Contractor's schedule for the Project and accepted by the DFCM just prior to the commencement of the modification, asserted delay, suspension or interruption. If the Contractor believes it is entitled to an extension of Contract Time under the Contract Documents, the Contractor shall submit a

PCO in accordance with Article 7.2 to the A/E and the DFCM Representative accompanied by an analysis ("Requested Time Adjustment Schedule") in accordance with the Contract Documents for time extensions. The "Requested Time Adjustment Schedule" shall include "fragnets" that represent the added or changed work to the Schedule. The impact on unchanged activities caused by the changes and/or delays being analyzed shall be included in these fragnets.

A "fragnet" as used in these General Conditions and when used in the context of project scheduling is a subset of project activities that are inter-related by predecessor and successor relationships that are tied into the main schedule with identified start and completion points. Each fragnet may or may not be on the critical path. An entire schedule consists of a series of inter-related fragnets.

**4.7.13 EXCUSABLE DELAY**.

(1) **IN GENERAL**. If the Contractor is delayed at any time in the progress of the Work on the critical path schedule by an act or neglect of the DFCM or other causes beyond the Contractor's control or by other causes which the DFCM determines may justify delay, then the Contract Time shall be extended by Change Order. The Contractor shall immediately take all steps reasonably possible to lessen the adverse impact of such delay. Notwithstanding the above, to the extent any of the causes for delay were caused by the Contractor, reasonably foreseeable by the Contractor or avoidable by the Contractor, then to such extent the delay shall not be cause for extension of the Contract Time. For purposes of this paragraph, Contractors shall include all subcontractors and others under the responsibility of the Contractor.

The determination of the total number of days extension will be based upon the current construction schedule in effect at the inception of the change and/or delay and upon all data relevant to the extension as it exists in the project record. Once approved, such data shall be incorporated in the next monthly update of the schedule.

Contractor acknowledges and agrees that delays in work items which, according to the schedule analysis, do not affect any milestone dates or the Contract completion dates shown on the CPM at the time of the delay, will not be the basis for a contract extension.

(2) **WEATHER-RELATED EXCUSABLE DELAYS**. Completion time will not be extended for normal bad weather or any weather that is reasonably foreseeable at the time of entering into the contract. The time for completion as stated in the contract documents includes due allowance for calendar days on which Work cannot be performed out of doors. The Contractor acknowledges that it may lose days due to weather conditions. Contract time may be extended at no cost to the DFCM if all of the following are met which must be established by the Contractor:

(a) That the weather prevented Work from occurring that is on the critical path for the project based upon a critical path schedule previously submitted to the DFCM and to the extent accepted by the DFCM;

(b) There are no concurrent delays attributed to the Contractor;

(c) The Contractor took all reasonable steps to alleviate the impact of the weather and took reasonable attempts to prevent the delay and despite such reasonable actions of Contractor, the weather impacted the critical path as described above; and

(d) One of the following occurred:

1. The weather was catastrophic, such as a tornado, hurricane, severe wind storm, severe hail storm; or

2. Based on the full history of information published from the closest station as indicated from the Western Regional Climate Center (Desert Research Institute 2215 Raggio Parkway Reno, Nevada 89512, and as may be described on the website at http://www.wrcc.dri.edu/summary/), one or more of the following occurred:

a. For any day between November 1 and March 31, the

minimum temperature fell below the average minimum temperature plus the extreme low temperature recorded for the month divided by 2.

b. For any day between November 1 and March 31, the maximum temperature fell below the monthly average for the minimum temperature.

c. The daily precipitation exceeded 75% of the historical one day maximum for the month.

d. The snowfall for the month exceeded 175% of the historical average snow fall for the month.

**4.7.14 COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION**.

(1) **BASIC CONDITIONS**. In addition to the other requirements of the Contract Documents, a compensable delay, suspension or interruption of the work occurs only when the following are met:

(a) Is wholly unanticipated by the parties at the time of execution of the Contractor's Agreement or is caused by the breach of a fundamental obligation of the Contract Documents attributable to the DFCM; and

(b) The Contractor delivers a written notice to A/E and DFCM within seven (7) days that the Contractor knows or should have known of the condition giving rise to the purported compensable delay, disruption, suspension or interruption, and said continuation affects the Contract Time as indicated by the last submitted and reasonable critical path schedule.

(2) **COMPENSABLE DELAY FORMULA**. To the extent of the compensable delay, the Contractor's total entitlement for all compensable delay damages is the computed result of the following formula: Contract Sum divided by Contract Time (in calendar days); the result of which is then multiplied by 0.05; and the result of which is multiplied by the number of calendar days of compensable days allowed under these General Conditions that are beyond the Contract Time. Notwithstanding any other provision of these General Conditions or the Contract Documents, to the extent the Contractor is entitled to receive the 10% or 15% markup under Article 7.4, this provision shall be inapplicable and the markup shall be deemed to include all the compensable delay damages provided by this paragraph.

(3) **PERIOD OF COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION**. The length and extent of compensable delay, shall be determined, with the use of the Project's critical path schedule, by ascertaining the number of additional days to the Contract Time that are needed in order to perform the Work in accordance with the Contract Documents as a result of the continuation of the aforesaid delay, disruption, suspension or interruption after receipt of the written notice received by the A/E and DFCM under Section 4.7.14(1)(b) above.

(4) **CONCURRENT DELAY**. Notwithstanding any other provision of these General Conditions, to the extent a non-compensable delay occurs at the same time as a compensable delay, the DFCM shall not be responsible for any compensation for the period of the non-compensable delay.

**4.7.15 TIME EXTENSION REQUESTS**. Any time extension shall be requested within 21 days after the Contractor knew or should have known about the delay and shall be supported by the critical path schedule analysis.

**4.7.16 LIQUIDATED DAMAGES**.

(1) **IN GENERAL**. Should the Contractor fail to complete the Work within the Contract Time, there shall be deducted from any amount due or that may become due the Contractor, the sum as stated in the Contractor's Agreement. Such sum is fixed and agreed upon by the DFCM and Contractor as liquidated damages due the DFCM by reason of the inconvenience and added costs of administration, engineering, supervision and other costs resulting from the Contractor's default, and not as a penalty. Actual damages related to delay can not be ascertained at

the time of execution of the Contract. To the extent that the liquidated damages exceed any amounts that would otherwise be due the Contractor, the Contractor shall be liable for such excess to the DFCM. DFCM may seek enforcement of such obligation by legal action, and if such is necessary, shall recover the related costs and attorney fees. Notwithstanding any other provision of these General Conditions, the availability of liquidated damages to the DFCM shall not limit the DFCM's right to seek damages or other remedies available under law or equity to the extent such damages or remedies are not based upon delay.

(2) **NO WAIVER OF DFCM'S RIGHTS**. Permitting the Contractor to continue any part of the Work after the time fixed for completion or beyond any authorized extension thereof, shall in no way operate as a waiver or estoppel on the part of the DFCM of any of its rights under the Contract Documents, including the right to liquidated damages or any other remedies or compensation.

**4.8 DOCUMENTS AND SAMPLES AT THE SITE, CERTIFYING "AS-BUILTS".** The Contractor shall maintain at the site for the DFCM, one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked weekly to record changes and selections made during construction, as well as approved Shop Drawings, Product Data, Samples and similar submittals. These aforesaid items shall be available to the A/E and shall be delivered to the A/E for submittal to the DFCM upon completion of the Work, signed by the Contractor, certifying that they show complete and exact "as-built" conditions, stating sizes, kind of materials, vital piping, conduit locations and similar matters. All notes of encountered or changed conditions shall be included.

**4.9 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.**

**4.9.1 NOT CONTRACT DOCUMENTS**. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The submittal shall demonstrate, for those portions of the Work for which the submittal is required, the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

**4.9.2 PROMPTNESS**. The Contractor shall review, approve and submit to the A/E, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work, or the activities of the DFCM or separate contractors.

**4.9.3 NOT PERFORM UNTIL A/E APPROVES**. The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved in writing by the A/E. Such Work shall be in accordance with the approved submittals.

**4.9.4 REPRESENTATIONS BY CONTRACTOR**. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**4.9.5 CONTRACTOR'S LIABILITY**. The Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the A/E's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the A/E in writing of such deviation at the time of the submittal and the A/E has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the A/E's review and comment.

**4.9.6 DIRECT SPECIFIC ATTENTION TO REVISIONS**. The Contractor shall direct specific attention in writing to all revisions on resubmitted Shop Drawings, Product Data, Samples or similar submittals, except those

requested by the A/E and indicated on previous submittals.

**4.9.7 INFORMATIONAL SUBMITTALS**. Informational submittals upon which the A/E is not expected to take responsive action may be so identified in the Contract Documents.

**4.9.8 RELIANCE ON PROFESSIONAL CERTIFICATION**. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the DFCM and A/E shall be entitled to rely upon the accuracy and completeness of such calculations and certifications. If a professional stamp is required, the professional shall be licensed in the State of Utah unless otherwise approved by the DFCM in writing. Likewise, the Contractor is entitled to rely upon the accuracy and completeness of the calculations made by the A/E in developing the Contract Documents, unless a Contractor of ordinary skill and expertise for the type of Work involved would know that such is inaccurate or incomplete and therefore must immediately notify the DFCM in writing.

**4.10 USE OF SITE.**

**4.10.1 IN GENERAL**. The Contractor shall confine operations at the site to areas permitted by the Contract Documents, law, ordinances, resolutions, rules and regulations, and permits and shall not unreasonably encumber the site with materials or equipment. Contractor shall take all reasonable means to secure the site, protect the site and protect the Work from any damage. The site shall be left free and clear of refuse, equipment, materials, etc. and the site shall not be subject to spilled liquids and chemicals, toxic or otherwise. Should such an incident occur while the Contractor has control of the site, the Contractor shall be responsible to clean the site and pay all associated costs, fines and penalties. Notwithstanding this, Contractor is not responsible for any damage to the site or the Work to the extent caused by the DFCM or the DFCM's agents.

**4.10.2 ACCESS TO NEIGHBORING PROPERTIES**. The Contractor shall not, except as provided in the Contract Documents or with the DFCM's advance written consent when necessary to perform the Work, interfere with access to properties neighboring the Project site by the owners of such properties and their respective tenants, agents, invitees and guests.

**4.11 ACCESS TO WORK**. The Contractor shall provide the DFCM and A/E access to the Work in preparation and progress, wherever located.

**4.12 ROYALTIES AND PATENTS**. The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the DFCM and A/E harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the DFCM in writing.

**4.13 INDEMNIFICATION**.

**4.13.1 IN GENERAL**.

(1) To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the State of Utah, the State of Utah's institutions, agencies, departments, divisions, authorities, and instrumentalities, boards, commissions, elected or appointed officers, employees, agents, authorized volunteers (hereinafter the above listing of entities and persons is referred to an "indemnities") from and against every kind and character of claims, damages, losses and expenses, including but not limited to attorneys' fees, and including those events covered under the blanket Contractual Liability Coverage required under the Contract Documents, arising out of or resulting from any act or omission in the performance of the Work including the work of all the Subcontractors and their employees, provided that any such claim, damage, loss or expense is caused in whole or in part by the negligent or wrongful act or omission

of the Contractor, any Subcontractor, and their employees, provided that any such claim, damage loss or expense is caused in whole or in part by the negligent or intentional act or omission of the Contractor, any Subcontractor, or anyone directly or indirectly employed or the agent of any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. The Contractor shall defend all actions brought upon such matters to be indemnified hereunder and pay all costs and expenses incidental thereto, but the State of Utah shall have the right, at its option, to participate in the defense of any such action without relieving the Contractor of any obligation hereunder. Notwithstanding any of the above, to the extent the Contractor is complying with a written directive from the DFCM, that is not based on the Contractor's recommendation, the Contractor shall not be held liable under the indemnification provision of this Agreement if the Contractor has promptly disagreed with the written directive by delivering such objection to the DFCM in writing.

(2) Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person under Contract Documents.

(3) In claims against any person or entity indemnified under this Article 4.13 by an employee of the Contractor, Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Article 3.13 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' or workmen's compensation acts, disability benefits acts or other employee benefit acts.

## ARTICLE 5. SUBCONTRACTORS.

### 5.1 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK.

**5.1.1 APPROVAL REQUIRED.**

(1) Listing of Subcontractors shall be as required by U.C.A. 63A-5-208 as amended and/or as stated in the Contract Documents, including but not limited to the "DFCM Subcontractors List Form".

(2) The Contractor shall not contract with a proposed person or entity to whom the DFCM has made a reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

**5.1.2 BUSINESS AND LICENSING REQUIREMENTS**. All Subcontractors used by the Contractor shall comply with all applicable business and licensing requirements.

**5.1.3 SUBSEQUENT CHANGES**. After the lapse of twenty-four (24) hours from the bid opening, the Contractor may change its listed Subcontractors only in accordance with Rule R 23-1 and the Contract Documents and with written approval of the Director of the Division of Facilities Construction and Management.

(1) DFCM will pay the additional costs for a DFCM requested change in subcontractor if all of the following are met:

(a) If the DFCM in writing requests the change of a subcontractor;

(b) The original subcontractor is a responsible subcontractor that meets the requirements of the Contract Documents; and

(c) The original subcontractor did not withdraw as a subcontractor on the project.

(2) In all other circumstances, the Contractor shall pay the additional cost for a change in a subcontractor.

**5.1.4 BONDING OF SUBCONTRACTORS**. Subcontractors as identified by DFCM in the procurement documents, may be required to submit

performance and payment bonds to cover the full extent of their portion of the Work. This provision does not in any way limit the right of the Contractor to have subcontractors at any tier be required to have a performance and/or payment bond.

**5.2 SUBCONTRACTUAL RELATIONS**.

**5.2.1 COMPLY WITH CONTRACT DOCUMENTS**. By appropriate enforceable agreement, and to the extent it can be practically applied, the Contractor shall require each Subcontractor to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes towards the DFCM and A/E.

**5.2.2 RIGHTS**. Each Subcontractor agreement shall preserve and protect the rights of the DFCM and A/E under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Subcontractor agreement, the benefit of all rights and remedies against the Contractor that the Contractor, by the Contract Documents, has against the DFCM.

**5.2.3 SUB-SUBCONTRACTORS**. The Contractor shall require each Subcontractor to enter into similar agreements with its Subcontractors which complies with the requirements of Paragraphs 5.2.1 and 5.2.2 hereinabove.

**5.2.4 DOCUMENT COPIES**. The Contractor shall make available to each proposed Subcontractor, prior to execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound. Subcontractors shall similarly make copies of applicable portions of the Contract Documents available to their respective proposed Subcontractors.

**5.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS**.

**5.3.1 CONDITIONS FOR ASSIGNMENT TO DFCM**. Each subcontract agreement for a subcontractor at any tier for a portion of the Work is assigned by the Contractor to the DFCM provided that the assignment is effective only after termination of the Contract by the DFCM for cause pursuant to Article 12.2 or stoppage of the Work by DFCM pursuant to Article 12.5, and only for those subcontract agreements which the DFCM accepts by notifying the Subcontractor in writing. The subcontract shall be equitably adjusted to meet the new conditions of the work.

## ARTICLE 6. PROTECTION OF PERSONS AND PROPERTY.

**6.1 SAFETY OF PERSONS AND PROPERTY.**

**6.1.1 CONTRACTOR RESPONSIBILITY**. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions for the safety of, and shall provide reasonable protection to prevent damage, injury or loss to:

(1) Employees on the Work and other persons who may be affected thereby;

(2) The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or a Subcontractor; and

(3) Other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

**6.1.2 SAFETY PROGRAM, PRECAUTIONS**. The Contractor shall institute a safety program at the start of construction to minimize accidents. Said program shall continue to the final completion of the Project and conform to applicable laws and regulations including the Utah Occupational Safety and Health Rules and

Regulations as published by the Utah Industrial Commission - UOSH Division. The Contractor shall post signs, erect barriers, and provide those items necessary to implement the safety program. As soon as the Contractor proceeds with the Work, the Contractor shall have all workers and all visitors on the site wear safety hard hats, as well as all other appropriate safety apparel such as safety glasses and shoes, and obey all safety rules and regulations and statutes. The Contractor shall post a sign in a conspicuous location indicating the necessity of wearing hard hats and the Contractor shall loan such hats to visitors.

**6.1.3 COMPLIANCE WITH LAWS**. The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss. In particular, the Contractor shall comply with all applicable provisions of Federal, State and municipal safety laws, rules and regulations as well as building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where the Work is being performed.

**6.1.4 ERECT AND MAINTAIN SAFEGUARDS**. The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including effective fences, posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

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

**6.1.6 PROMPT REMEDY**. The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Paragraph 6.1.1 of these General Conditions caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under said Paragraph 6.1.1, except to the extent such damage or loss is directly due to errors in the Contract Documents or caused by agents or employees of the A/E or DFCM. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under the Contract Documents.

**6.1.7 SAFETY DESIGNEE**. The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, damage, injury or loss. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the DFCM and A/E.

**6.1.8 LOAD SAFETY**.
The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

**6.1.9 OFF-SITE RESPONSIBILITY**. In addition to its other obligations under this Article 6, the Contractor shall, at its sole cost and expense, promptly repair any damage or disturbance to walls, utilities, streets, ways, sidewalks, curbs and the property of the State and third parties (including municipalities and other governmental agencies) resulting from the performance of the Work, whether by it or by its Subcontractors at any tier. The Contractor shall not cause materials, including soil and debris, to be placed or left on streets or ways.

**6.1.10 EMERGENCIES**.
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Contractor shall promptly notify the DFCM Representative of the action taken.

**6.2 HAZARDOUS MATERIALS**. In the event the Contractor encounters on the site material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) or any other hazardous waste or substance which may endanger the health of those persons performing the Work or being on the site**,** the Contractor shall immediately stop Work in the area affected and

immediately report the condition to the DFCM Representative and A/E by phone with a follow-up document in writing. The Work in the affected area shall be resumed when written direction is provided by the DFCM Representative. Except to the extent provided otherwise in the Contract Documents or if the presence of hazardous materials is due to the fault of the Contractor, the Contractor shall not be required to perform without the Contractor's consent, any Work relating to asbestos, polychlorinated biphenyl (PCB) or any other hazardous waste or substance.

DFCM shall procure a licensed abatement contractor qualified to remove the hazardous material. The abatement contractor shall submit notification of demolition to the Utah Division of Air Quality. Abatement contractor shall pay the notification fee. A copy of the hazardous material survey report shall be available to all persons who have access to the construction site.

**6.3 HISTORICAL AND ARCHEOLOGICAL CONSIDERATIONS.** In the event the Contractor knows or should have known of any cultural, historical or archeological material that is either recognized as an item to be protected under Federal, State, or local law or regulation, or is an item of obvious value to the State of Utah, the Contractor shall cease any work that would interfere with such discovery and immediately report the condition to the DFCM Representative and A/E by phone with a follow-up document in writing. Work shall resume based upon the direction of the DFCM Representative. Contractor cooperation with any DFCM recognized archaeologist or other cultural/historical expert is required.

**6.4 CONTRACTOR LIABILITY.** If the Contractor fails in any of its obligations in Articles 6.1 through 6.3 above, the Contractor shall be liable to any damages to DFCM, the State of Utah or any third party resulting from such noncompliance. The Contractor shall also be liable for any mitigation or restoration effort resulting from such noncompliance. To the extent all the following is met, the Contractor may treat the discovery of such material similarly to an unforeseen condition:

6.4.1 The discovery of such material is reasonably unforeseeable given the site conditions that the Contractor should have been aware;

6.4.2 The presence of such material was not identified in any part of the Contract Documents;

6.4.3 The Contractor has undertaken all proper action to mitigate any impact of such discovery on the critical path or monies related to the Project;

6.4.4 The discovery affects the critical path or contract price from that which was contemplated by the Contract Documents; and

6.4.5 The requirements of 7.1.5 and the Contract documents are met.

## ARTICLE 7. MODIFICATIONS, REQUEST FOR INFORMATION, PROPOSED CHANGE ORDER, PRELIMINARY RESOLUTION EFFORTS AND CLAIMS PROCESS.

### 7.1 MODIFICATIONS: IN GENERAL.

**7.1.1 TYPES OF MODIFICATIONS AND LIMITATIONS**. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or ASI, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. The Contractor must have a written Modification executed by DFCM under this Article 7 prior to proceeding with any Work sought to be an extra.

**7.1.2 BY WHOM ISSUED**. A Change Order or Construction Change Directive shall be issued by the DFCM Representative. An ASI is issued by the A/E or by the DFCM Representative.

The A/E shall prepare Change Orders and Construction Change Directives with specific documentation and data for the DFCM's approval and execution in accordance with the Contract Documents, and may issue ASIs not involving an adjustment in the contract sum or an extension of the Contract Time which are not

inconsistent with the intent of the Contract Documents.

**7.1.3 CONTRACTOR TO PROCEED UNLESS OTHERWISE STATED.** Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or ASI.

**7.1.4 ADJUSTING UNIT PRICES**. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed will cause a substantial inequity to the DFCM or Contractor, the applicable unit prices may be equitably adjusted.

**7.1.5 SPECIAL NOTICES REQUIRED IN ORDER TO BE ELIGIBLE FOR ANY CONTRACT MODIFICATION.** In order to be eligible for any Modification under this Article 7, the Contractor must have met the following special notice requirements:

(1) **CONCEALED OR UNKNOWN CONDITIONS**. The Contractor must file a written notice with the DFCM Representative within seven (7) calendar days of that the Contractor knew or should have known of a site condition described below or the Contractor shall be deemed to waive any right to file any PCO, PRE or Claim for additional monies or time related to such condition:

(a) If the Contractor encounters unknown and reasonably unforeseeable subsurface or otherwise concealed physical conditions, including hazardous or historical/cultural materials under Article 6, which differ materially from those indicated by the Contract Documents or a site inspection; or

(b) If the Contractor encounters unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents.

(2) **INCREASE IN CONTRACT TIME**. If the Contractor encounters a situation in which the Contractor knows or should have known that such situation would cause a delay, disruption, interruption, suspension or the like to the Project, the Contractor must file a notice with the DFCM Representative within seven (7) working days of when the Contractor knew or should have known of such circumstance or the Contractor shall be deemed to waive any right to file any PCO, PRE or Claim for additional monies or time related to such circumstance. To the extent the DFCM and/or the State of Utah is damaged by the failure of the Contractor to provide such notice after the Contractor knows or should have known of such circumstance, the Contractor shall be liable for liquidated damages attributable thereto, as well as any damages to the State of Utah and/or DFCM that are allowable in addition to liquidated damages.

**7.2 CONTRACTOR INITIATED REQUESTS.**

**7.2.1 THE REQUEST FOR INFORMATION, RFI, PROCESS AND TIME TO FILE.** The Contractor may file an RFI with the A/E regarding any concern which will assist the Contractor in the proper completion of the Work including, but not limited to issues related to the Contract Documents, plans and specifications. The RFI shall be filed with the A/E in a timely manner so as not to prejudice the DFCM as to the quality, time or money related to the Work.

**7.2.2 PROPOSED CHANGE ORDER ("PCO").** Within twenty-one (21) days after the Contractor knows or should have known of a situation or concern where the Contractor is going to request additional monies or time, the Contractor must file a Proposed Change Order ("PCO") with the DFCM Representative, or the Contractor shall be deemed to waive any right to claim additional monies or time related to such situation or concern. The PCO shall include all available documentation supporting the PCO available to the Contractor at the time of filing and the Contractor shall thereafter diligently pursue the

supplementation(s) of such documentation and promptly deliver such supplementation(s) to the DFCM Representative.

(1) **DFCM REPRESENTATIVE RESPONSE.** One of the following may occur after a PCO is filed with the DFCM Representative:

(a) The DFCM Representative, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

(b) The DFCM, after considering any input by the A/E, may issue a Construction Change Directive.

(c) If the DFCM Representative, after considering any input by the A/E, disagrees with the Contractor's PCO, the DFCM representative may seek additional information or verification from the Contractor, the A/E or other sources, may negotiate with the Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive.

(d) If a Construction Change Directive is issued which identifies the DFCM Representative's position in regard to the subject contract sum and/or time adjustment or if the PCO is denied by the DFCM Representative, the Contractor must file a PRE under Article 7.7 below no later than twenty-one (21) days after the Contractor's receipt of the Construction Change Directive or such denial of the PCO. Failure to file a PRE in these instances shall be deemed to waive any right to additional time or money related to the PCO, Construction Change Directive or denial of the PCO. Such waiver shall entitle the DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by the Contractor.

If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the time period for commencement of filing the PRE shall not accrue until such time as the DFCM has conveyed to the Contractor a position as to the time and money owing as a result of the directed change.

The A/E must continually work with the DFCM in providing data, documentation and efforts to resolve the issues related to the PR.

**7.3 PROPOSAL REQUEST INITIATED BY DFCM.** DFCM may file a Proposal Request with the Contractor seeking information, data and/or pricing relating to a change in the contract time and or monies owing for particular scope changes or other modifications to the Contract Documents. The PR shall provide a time limit for the Contractor to file a response with the A/E and the DFCM Representative. If a proposal is not timely provided by the Contractor, DFCM may calculate the Change Order under Article 7.4.2 below. Upon such timely receipt of the proposal, one of the following shall occur:

**7.3.1 IF AGREEMENT, CHANGE ORDER ISSUED.** The DFCM Representative, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

**7.3.2 IF DISAGREEMENT**. If the DFCM Representative disagrees with the Contractor's proposal, after considering any input from the A/E, the DFCM representative may seek additional information or verification from the Contractor or other sources, may negotiate with the Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. If a Construction Change Directive is issued which identifies the DFCM representative's position in regard to the subject contract sum and/or time adjustment, the Contractor must file a PRE within twenty-one (21) days of the Contractor's receipt of the Construction Change Directive, or the Contractor shall be deemed to waive any such request for additional time or money as a result of the issuance of the Construction Change Directive. Such waiver shall entitle the DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by the Contractor. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the time period for commencement of filing the PRE shall not accrue until such time as the DFCM has conveyed

to the Contractor a position as to the time and money owing as a result of the directed change.

**7.4 EVALUATION OF PROPOSAL FOR ISSUING CHANGE ORDERS**.

**7.4.1 ADJUSTING SUM BASED UPON AGREEMENT.** If the Change Order provides for an adjustment to the Contract Sum, the adjustment shall be based on the mutual agreement of the Contractor and DFCM, including any terms mandated by unit price agreements or other terms of the Contract Documents.

**7.4.2 DFCM RESOLUTION OF SUM AND STANDARDS IN THE ABSENCE OF AN AGREEMENT UNDER PARAGRAPH 7.4.1.** In the absence of an agreement under Paragraph 7.4.1 above, the adjustment shall be based on an itemized accounting of costs and savings supported by appropriate data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Paragraph shall be limited to the following:

(1) All direct and indirect costs of labor; including workers compensation insurance, social security and other federal and state payroll based taxes, and payroll based fringe benefits paid by Contractor so long as they are reasonable and no higher than that charged to other clients;

(2) Costs of materials, on-site temporary facilities, supplies and equipment (except hand tools) required for or incorporated into the work;

(3) Rental costs of machinery, equipment, tools (except hand tools), and on-site temporary facilities, whether rented from the Contractor or others;

(4) Costs of permits and other fees, sales, use or similar taxes related to the Work;

(5) Additional costs of field supervision and field office personnel directly attributable to the change; and

(6) Overhead and profit by the following liquidated formula which is not a penalty but a reasonable calculation agreed upon at the time of execution of the Contractor's Agreement, and provided by formula herein due to the fact that the actual amount due for said overhead and profit cannot easily be ascertained at the time of such execution. The markups in 7.4.2(6)(a) and (b) below are to cover the Contractor's additional payment and performance bond premiums, insurance premiums not specified under Paragraph 7.4.2(1), home office and on-site overhead and profit. Overhead and profit includes, but is not limited to the Contractor's Project Manager and Cost Estimator. Each request for pricing shall stand on its own and not be combined with other requests for pricing in determining the allowed markup described below. A particular request for pricing shall include all items reasonably related together and determinable at the time of the request. If several unrelated requests for pricing are grouped together in a single Change Order, each request for pricing will be considered separately for purposes of calculating the markup under the following formula:

(a) A markup of 15% shall be applied to the cost of each individual charge up to $20,000 in cost, but in no case shall the markup be less than $150;

(b) A markup of 10% shall be applied to the portion of the cost of each individual charge in excess of $20,000;

(c) Subcontractors at any tier shall be entitled to markup their costs related to a Change Order with the same percentages as specified in Paragraphs 7.4.2(6)(a) and (b) above, except that the minimum markup shall be $50 for any individual change.

**7.4.3 CREDITS**. The amount of credit to be allowed by the Contractor to the DFCM for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed to DFCM based upon corroboration by an appropriate source.

**7.5 CONSTRUCTION CHANGE DIRECTIVES**.

**7.5.1 WHEN USED AND CONTRACTOR'S RIGHT TO CHALLENGE**. A Construction Change Directive may be issued by the DFCM Representative in the case of a need for the Work to commence. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the Construction Change Directive shall indicate the timeframe(s) in which further information is to be provided to resolve the matter. At any time that the DFCM and the Contractor agree upon the time and money related to a Construction Change Directive, a Change Order shall be executed by the parties. Additionally, the Construction Change Directive may be converted to a Change Order under Paragraph 7.2.2 or Article 7.3 above.

**7.5.2 PROCEED WITH WORK AND NOTIFY DFCM ABOUT ADJUSTMENT METHOD**. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved.

**7.5.3 INTERIM PAYMENTS BY DFCM.** Pending the final determination of the total cost of the Construction Change Directive, DFCM shall pay any undisputed amount to the Contractor.

**7.6 A/E'S SUPPLEMENTAL INSTRUCTION (Commonly referred to as an "ASI").** The A/E may at any time that is consistent with maintaining the quality, safety, time, budget and function of the Work, issue to the Contractor a supplemental instruction ("ASI") after approval from the DFCM Representative is obtained. The Contractor must file with the DFCM Representative a PCO under Paragraph 7.2.2 above, within 21 calendar days of the Contractor's receipt of the ASI, or the Contactor shall be deemed to have waived any right to additional time or monies as a result of such ASI.

**7.7 PROCEDURE FOR PRELIMINARY RESOLUTION EFFORTS.**

**7.7.1 REQUEST FOR PRELIMINARY RESOLUTION EFFORT (PRE).** A Contractor raising an issue related to a breach of contract or an issue concerning time or money shall file a PRE as a prerequisite for any consideration of the issue by the DFCM. The labeling of the notice or request shall not preclude the consideration of the issue by the DFCM.

**7.7.2 TIME FOR FILING**. The PRE must be filed in writing with the DFCM Representative within twenty-one (21) days of any of the following:

(1) Issuance of a Construction Change Directive that defines the time and sum due the Contractor but the Contractor disagrees with such assessment;

(2) Issuance of DFCM's position in regard to a Construction Change Directive that originally left open the time and/or sum due to the Contractor;

(3) Issuance of a denial of a PCO by DFCM;

(4) In the case of a Subcontractor, after the expiration of the time period for the Contractor/Subcontractor PRE process under Paragraph 7.7.5 below; or

(5) When the Contractor knows or should have known about any other issue where the Contractor seeks additional monies, time or other relief from the State of Utah or DFCM.

**7.7.3 CONTENT REQUIREMENT.** The PRE shall be required to include in writing to the extent information is reasonably available at the time of such filing:

(1) A description of the issue;

(2) The potential impact on cost and time or other breach of contract; and

(3) An indication of the relief sought.

**7.7.4 SUPPLEMENTATION.** Additional detail of the content requirement under Paragraph 7.7.3 above shall be provided later if the detail is not yet available at the initial filing as follows:

(1) While the issue is continuing or the impact is being determined, the Contractor shall provide a written updated status report every 30 days or as otherwise reasonably requested by the DFCM Representative; and

(2) After the scope of work or other factors addressing the issue are completed, the complete information, including any impacts on time, cost or other relief requested, must be provided to the DFCM Representative within twenty-one (21) days of such completion.

**7.7.5 SUBCONTRACTORS.**

(1) Under no circumstances shall any provision of these Contract Documents be intended or construed to create any contractual relationship between the DFCM and any Subcontractor.

(2) The Contractor must include the provisions of this Paragraph 7.7.5 in its contract with the first tier Subcontractor, and each Subcontractor must do likewise. At the Contractor's discretion, the Contractor may allow a Subcontractor at the 2nd tier and beyond to submit the PRE directly with the Contractor.

(3) In order for a Subcontractor at any tier to be involved with the PRE of the DFCM, the following conditions and process shall apply:

(a) The Subcontractor must have attempted to resolve the issue with the Contractor including the submission of a PRE with the Contractor.

(b) The Subcontractor must file a copy of the PRE with the DFCM Representative;

(c) The PRE to the Contractor must meet the time, content and supplementation requirements of Paragraphs 7.7.2, 7.7.3 and 7.7.4. The triggering event for a Subcontractor to file a PRE shall be the time at which the issue cannot be resolved through the normal business practices associated with the contract, excluding arbitration and litigation;

(d) The PRE submitted to the Contractor shall only be eligible for consideration in the DFCM's PRE process to the extent the issue is reasonably related to the performance of the DFCM or an entity for which the DFCM is liable;

(e) The Contractor shall resolve the PRE to the satisfaction of the Subcontractor within sixty (60) days of its submittal to the Contractor or such other time period as subsequently agreed to by the Subcontractor in writing. If the Contractor fails to resolve the PRE with the Subcontractor within such required time period, the Subcontractor may submit in writing the PRE with the Contractor and the DFCM. In order to be eligible for DFCM consideration of the PRE, the Subcontractor must submit the PRE within twenty-one (21) days of the expiration of the time period for the Contractor/Subcontractor PRE process. The DFCM shall consider the PRE as being submitted by the Contractor on behalf of the Subcontractor;

(f) Upon such PRE being submitted, the Contractor shall cooperate with the DFCM Representative in reviewing the issue;

(g) The DFCM shall not be obligated to consider any submission which is not in accordance with any provision of this Article 7.7;

(h) The Subcontractor may accompany the Contractor in participating with the DFCM regarding the PRE raised by the Subcontractor. The DFCM is not precluded from meeting with the Contractor separately and it shall be the responsibility of the Contractor to keep the Subcontractor informed of any such meetings; and

(i) Notwithstanding any provision of this Paragraph 7.7.5, a Subcontractor shall be entitled to pursue a payment bond claim.

**7.7.6 PRE RESOLUTION PROCEDURE.** The DFCM Representative may request additional information and may meet with the parties involved with the issue.

**7.7.7 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE.** Pending the final resolution of the issue, unless otherwise agreed upon in writing by the DFCM Representative, the Contractor shall proceed diligently with performance of the Contract and the DFCM shall continue to make payments in accordance with the Contract Documents.

**7.7.8 DECISION**. The DFCM shall issue to the Contractor, and any other party brought into the process by the DFCM Representative as being liable to the DFCM, a written decision providing the basis for the decision on the issues presented by all of the parties within thirty (30) days of receipt of all the information required under Paragraphs 7.7.3 and 7.7.4.

**7.7.9 DECISION FINAL UNLESS CLAIM SUBMITTED**. The decision by the DFCM shall be final, and not subject to any further administrative or judicial review (not including judicial enforcement) unless a Claim is submitted in accordance with these General Conditions.

**7.7.10 EXTENSION REQUIRES MUTUAL AGREEMENT**. Any time period specified in this Article 7.7 may be extended by mutual agreement of the Contractor and the DFCM.

**7.7.11 IF DECISION NOT ISSUED.** If the decision is not issued within the thirty (30) day period, including any agreed to extensions, the issue may be pursued as a Claim.

**7.7.12 PAYMENT FOR PERFORMANCE**.

(1) Except as otherwise provided in the Contract Documents, any final decision where the DFCM is to pay additional monies to the Contractor, shall not be delayed by any PRE, Claim or appeal by another party.

(2) Payment to the Contractor of any final decision shall be made by the DFCM in accordance with the contract for the completed work.

(3) Notwithstanding any other provision of the Contract Documents, payment to the Contractor shall be subject to any set-off, claims or counterclaims of the DFCM.

(4) Payment to the Contractor for a Subcontractor issue submitted by the Contractor shall be paid by the Contractor to the Subcontractor in accordance with the contract between the Contractor and the Subcontractor.

(5) Any payment or performance determined owing by the Contractor to the DFCM shall be made in accordance with the Contract Documents.

**7.8. RESOLUTION OF CLAIM.**

**7.8.1 CLAIM.** If the decision on the PRE is not issued within the required timeframe or if the Contractor is not satisfied with the decision, the Contractor or other party brought into the process by the DFCM, may submit a Claim in accordance with this Article 7.8 as a prerequisite for any further consideration by the DFCM or the right to any judicial review of the issue giving rise to the claim.

**7.8.2 SUBCONTRACTORS.** In order for a Subcontractor to have its issue considered in the Claim process by the DFCM, the Subcontractor that had its issue considered under Paragraph 7.7.5 may submit the issue as a Claim by filing it with the Contractor and the DFCM within the same timeframe and with the same content requirements as required of a Claim submitted by the Contractor under this rule. The DFCM shall consider the Claim as being submitted by the Contractor on behalf of the Subcontractor. Under no circumstances shall any provision of these General Conditions or the Contract Documents be intended or construed so as to create any contractual relationship between the DFCM and any Subcontractor.

(1) Upon such Claim being submitted, the Contractor shall fully cooperate

with the Director, the person(s) evaluating the claim and any subsequent reviewing authority.

(2) The Director shall not be obligated to consider any submission which is not in accordance with this Paragraph 7.8.2.

(3) The Subcontractor may accompany the Contractor in participating with the Director, the person(s) evaluating the Claim and any subsequent reviewing authority regarding the Claim. The Director, the person(s) evaluating the Claim and any subsequent reviewing authority is not precluded from meeting with the Contractor separately, and it shall be the responsibility of the Contractor to keep the Subcontractor informed of any such meetings and matters discussed.

(4) Notwithstanding any provision of this Article 7.8, a Subcontractor shall be entitled to pursue a payment bond claim.

**7.8.3 TIME FOR FILING.** The Claim must be filed in writing promptly with the Director, but in no case more than twenty-one (21) days after the decision is issued on the PRE under Paragraph 7.7.8 or no more than twenty-one (21) days after the thirty (30) day period under Paragraph 7.7.11 has expired with a decision not issued, whichever is later.

**7.8.4 CONTENT REQUIREMENT.** The written Claim shall include:

(1) A description of the issues in dispute;

(2) The basis for the Claim, including documentation and analysis required by the contract and applicable law and rules that allow for the proper determination of the Claim;

(3) A detailed cost estimate for any amount sought, including copies of any related invoices; and

(4) A specific identification of the relief sought.

**7.8.5 EXTENSION OF TIME TO SUBMIT DOCUMENTATION.** The time period for submitting documentation and any analysis to support a Claim may be extended by the Director upon written request of the claimant showing just cause for such extension, which request must be included in the initial Claim submittal.

**7.8.6 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE**. Pending the final determination of the Claim, including any judicial review or appeal process, and unless otherwise agreed upon in writing by the Director, the Contractor shall proceed diligently with performance of the Contract and the DFCM shall continue to make payments in accordance with the Contract Documents.

**7.8.7 AGREEMENT OF CLAIMANT ON METHOD AND PERSON(S) EVALUATING THE CLAIM.** The Director shall first attempt to reach agreement with the claimant on the method and person(s) to evaluate the Claim. If such agreement cannot be made within fourteen (14) days of filing of the Claim, the Director shall select the method and person(s), considering the purposes described in Rule R23-26-1. Unless agreed to by the Director and the claimant, any selected person shall not have a conflict of interest or appearance of impropriety. Any party and the person(s) evaluating the Claim has a duty to promptly raise any circumstances regarding a conflict of interest or appearance of impropriety. If such a reasonable objection is raised, and unless otherwise agreed to by the Director and the claimant, the Director shall take appropriate action to eliminate the conflict of interest or appearance of impropriety. The dispute resolution methods and person(s) may include any of the following:

(1) A single expert and/or hearing officer qualified in the field that is the subject of the Claim;

(2) An expert panel, consisting of members that are qualified in a field that is the subject of the Claim;

(3) An arbitration process which may be binding if agreed to by the parties to the Claim;

(4) A mediator; or

(5) Any other method that best accomplishes the purposes set forth in Rule R23-26-1.

**7.8.8 THE EVALUATION PROCESS, TIMEFRAMES OF EVALUATOR(S), DIRECTOR'S DETERMINATION, ADMINISTRATIVE APPEAL TO THE EXECUTIVE DIRECTOR AND JUDICIAL REVIEW.** The Claim shall be evaluated, the timeframe for specific events related to the person(s) evaluating the Claim, the Director's determination, any appeal to the Executive Director and any judicial review shall be subject to the provisions of Rule R23-26-5(8), R23-26-5(9), R23-26-6 and R23-26-8. A copy of these Administrative Rules are available at DFCM.

**7.8.9 APPEAL PROCESS PREREQUISITE FOR FURTHER CONSIDERATION OR JUDICIAL REVIEW.** The administrative appeal to the Executive Director is a prerequisite for any further consideration by the State of Utah, or to judicial review of the issue giving rise to the Claim. It shall be considered that the Contractor, or another party brought into the process by the DFCM, has not exhausted its administrative remedies if such an administrative appeal is not undertaken.

**7.9 PAYMENT OF CLAIM.**

7.9.1 When a stand alone component of a Claim has received a final determination, and is no longer subject to review or appeal, that amount shall be paid in accordance with the payment provisions of the Contract Documents or judicial order.

7.9.2 When the entire Claim has received a final determination, and is no longer subject to review or appeal, the full amount shall be paid within fourteen (14) days of the date of the final determination unless the work or services has not been completed, in which case the amount shall be paid in accordance with the payment provisions of the Contract Documents to the point that the work or services is completed.

7.9.3 The final determination date is the earlier of the date upon which the claimant accepted the settlement in writing with an executed customary release document and waived its rights of appeal, or the expiration of the appeal period, with no appeal filed, or the determination made resulting from the final appeal.

7.9.4 Any final determination where the Division is to pay additional monies to the Contractor shall not be delayed by any appeal or request for judicial review by another party brought into the process by the Division as being liable to the DFCM.

7.9.5 Notwithstanding any other provision of the Contract Documents, payment of all or part of a Claim is subject to any set-off, claims or counterclaims of the DFCM.

7.9.6 Payment to the Contractor for a Subcontractor issue (Claim) deemed filed by the Contractor, shall be paid by the Contractor to the Subcontractor in accordance with the contract between the Contractor and the Subcontractor.

7.9.7 The execution of a customary release document related to any payment may be required as a condition of making the payment.

**7.10 ALLOCATION OF COSTS OF CLAIM RESOLUTION PROCESS.**

7.10.1 In order to file a Claim, a claimant must pay a $1500 filing fee to the DFCM. When the Claim is a pass-through from a Subcontractor in accordance with Paragraph 7.7.5, the payment of the fee shall be made by the Subcontractor.

7.10.2 Unless otherwise agreed to by the parties to the Claim, the costs of resolving the Claim shall be allocated among the parties on the same proportionate basis as the determination of financial responsibility for the Claim.

7.10.3 The costs of resolving the Claim that are subject to allocation include the claimant's filing fee, the costs of any person(s) evaluating the Claim, the costs of making any required record of the process, and any additional testing or inspection procured to investigate and/or evaluate the Claim.

7.10.4 Each party is responsible for its own attorney fees.

**7.11 ALTERNATIVE PROCEDURES.** To the extent otherwise permitted by law, if all parties to a Claim agree in writing, a protocol for resolving a Claim may be used that differs from the process described in this Article 7.

**7.12 IMPACT ON FUTURE SELECTIONS.**

7.12.1 The presentation of a good faith and non-frivolous issue or Claim shall not be considered by the DFCM's selection process for a future award of contract; and

7.12.2 The submission of a bad faith and frivolous issue or Claim, or the failure by a Contractor to facilitate resolution of a Claim, may be considered in the DFCM's evaluation of performance.

**7.13 REPORT TO BUILDING BOARD.** The DFCM may report on the claim to the Utah State Building Board.

**7.14 DFCM'S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED.** As stated in Rule R23-26-1(6), Articles 7.7 through 7.13 above do not limit the right of DFCM to have any of its issues, disputes or claims considered. DFCM reserves all rights to pursue its issues, disputes or claims in law or equity including, but not limited to, any or all of the following: damages, delay damages and impacts, losses, liability, patent or latent defects, or failure to perform under the Contract Documents. If the Director appoints an expert or a panel to consider any such issue(s), dispute(s) or claim(s) of DFCM, the Contractor shall cooperate with such expert or panel process.

## ARTICLE 8. PAYMENTS AND COMPLETION.

**8.1 SCHEDULE OF VALUES**. With the first Application for Payment, the Contractor shall submit to the A/E and the DFCM Representative a schedule of values allocated to all the various portions of the Work. The Schedule of Values shall be submitted on the form approved and provided by DFCM. The A/E shall make recommendations to the DFCM Representative regarding the Schedule of Values including any suggested modifications. When approved, including any approved modifications, by the DFCM Representative, it shall be the basis for future Contractor Applications for Payments. The Contractor shall not be entitled to payment until receipt and acceptance of the Schedule of Values.

**8.2 APPLICATIONS FOR PAYMENT**.

**8.2.1 IN GENERAL**. The following general requirements shall be met:

(1) The Contractor shall submit to the A/E an itemized Application for Payment for Work completed in accordance with the schedule of values and that reflects retainage as provided for in the Contractor's Agreement. The Application for Payment shall be on a special form approved and provided by DFCM.

(2) Such application shall be supported by such data substantiating the Contractor's right to payment as the DFCM or A/E may require. Said data may include, but is not limited to, copies of requisitions from Subcontractors.

(3) Such applications may include requests for payment pursuant to approved Change Orders or Construction Change Directives.

(4) Such applications may not include requests for payment for portions of the Work performed by a subcontractor when the Contractor does not intend to pay to a Subcontractor because of a dispute or other reason.

(5) In executing the Application for Payment, the Contractor shall attest that subcontractors involved with prior applications for payment have been paid, unless the Contractor provides a detailed explanation why such payment may not have occurred. DFCM reserves the right to require the Contractor to submit a payment waiver from one or more subcontractors.

**8.2.2 PAYMENT FOR MATERIAL AND EQUIPMENT**. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment

delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the DFCM and A/E, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the DFCM to establish the DFCM's title to such materials and equipment or otherwise protect the DFCM's interest, and shall include applicable insurance, storage and transportation to the site for such materials and equipment stored off the site. The DFCM may require copies of invoices or other suitable documentation.

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

**8.2.4 HOLDBACK BY DFCM**. Notwithstanding anything to the contrary contained in the Contract Documents, the DFCM may, as a result of the claims resolution process, withhold any payment to the Contractor hereunder if and for so long as the Contractor fails to perform any of its obligations hereunder or otherwise is in default under any of the Contract Documents.

**8.3 CERTIFICATES FOR PAYMENT**.

**8.3.1 ISSUED BY A/E.** The A/E shall within ten (10) days after receipt of the Contractor's Application for Payment, either issue to the DFCM a Certificate for Payment, with a copy to the Contractor, for such amount as the A/E determines due, or notify the Contractor and DFCM in writing of the A/E's reasons for withholding certification in whole or in part as provided in Paragraph 8.4.1. If the A/E fails to act within said ten (10) day period, the Contractor may file the Application for Payment directly with the DFCM Representative and the DFCM will thereafter have twenty (20) days from the date of the DFCM's receipt to resolve the amount to be paid and to pay the undisputed amount. The accuracy of the Contractor's Applications for Payment shall be Contractor's responsibility, not A/E's.

**8.3.2 A/E'S REPRESENTATIONS**. The A/E's issuance of a Certificate for Payment shall constitute a representation to the DFCM that to the best of the A/E's knowledge, information and belief, based upon the A/E's observations at the site, the data comprising the Application for Payment, and what is reasonably inferable from the observations and data, that the Work has progressed to the point indicated in the Application and that the quality of the work is in accordance with the Contract Documents. The foregoing representations are subject to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the A/E. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment shall not be a representation that the A/E has (a) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (b) reviewed construction means, methods, techniques, sequences or procedures, (c) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the DFCM to substantiate the Contractor's right to payment, (d) ascertained how or for what purpose the Contractor used money previously paid on account of Contract Sum, or (e) any duty to make such inquiries.

**8.4 DECISIONS TO WITHHOLD CERTIFICATION**.

**8.4.1 WHEN WITHHELD**. The A/E may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the DFCM, if in the A/E's judgment the representations to the DFCM required in

Paragraph 8.3.2 above can not be made. If the A/E is unable to certify payment in the amount of the Application, the A/E shall notify the Contractor and DFCM as provided in Paragraph 8.3.1 above. If the Contractor and A/E can not agree on a revised amount, the A/E shall promptly issue a Certificate for Payment for the amount to which the A/E makes such representations to the DFCM. The A/E may also decide not to certify payment or, because of subsequently discovered evidence or observations, may nullify the whole or part of a Certificate for Payment previously issued, to such extent as may be necessary in the A/E's opinion to protect the DFCM from loss because of:

(1) Defective Work not remedied;

(2) Third party claims filed or reasonable evidence indicating probable filing of such claims;

(3) Failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

(4) Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

(5) Damage to the DFCM or another contractor;

(6) Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

(7) Failure to carry out the Work in accordance with the Contract Documents.

**8.4.2 CERTIFICATION ISSUED WHEN REASONS FOR WITHHOLDING REMOVED.** When the reasons stated in Paragraph 8.4.1 for withholding certification are removed, certification will be made for such related amounts.

**8.4.3 CONTINUE WORK EVEN IF CONTRACTOR DISPUTES A/E'S DETERMINATION**. If the Contractor disputes any determination by the A/E or the result of the claims resolution process with regard to any Certification of Payment, the Contractor nevertheless shall expeditiously continue to prosecute the Work.

**8.4.4 DFCM NOT IN BREACH**. The DFCM shall not be deemed to be in breach of this Contract by reason of the withholding of any payment pursuant to any provision of the Contract Documents provided the DFCM's action or such withholding is consistent with the results of the dispute resolution process.

**8.5 PROGRESS PAYMENTS.**

**8.5.1 IN GENERAL, INTEREST OR LATE PAYMENTS.**

(1) Except as provided in Paragraph 8.3.1, the DFCM shall pay any undisputed amount within thirty (30) days of the date that the application for payment was submitted to the A/E. In no event shall DFCM be required to pay any disputed amount.

(2) Except as otherwise provided by law, if any payment is late based upon the provisions of the Contract Documents, the Contractor shall be paid interest in an amount equal to the published Wall Street Journal prime rate plus 2%. The published Wall Street Journal Prime Rate shall be determined using such rate that is published closest to the 1st of the month for each month of the late period. The amount of payment of interest shall be apportioned using such rate(s) for the late period.

**8.5.2 CONTRACTOR AND SUBCONTRACTOR RESPONSIBILITY**. The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the DFCM, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payment to its Subcontractors in a similar manner.

**8.5.3 INFORMATION FURNISHED BY A/E OR DFCM TO SUBCONTRACTOR**. The A/E or DFCM shall, on request, furnish to the Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the A/E and DFCM on account of portions of the Work done by such Subcontractor.

**8.5.4 DFCM AND A/E NOT LIABLE**. Neither the DFCM or A/E shall have an obligation to pay, monitor or enforce the payment of money to a Subcontractor, except to the extent as may otherwise be required by law.

**8.5.5 CERTIFICATE, PAYMENT OR USE NOT ACCEPTANCE OF IMPROPER WORK**. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the DFCM shall not constitute acceptance of Work that is not in accordance with the Contract Documents.

**8.6 PAYMENT UPON SUBSTANTIAL COMPLETION**. Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the A/E, the DFCM shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents. To the extent allowed by law, the DFCM may retain up to 200% of the fair market value of the work that has not been completed in accordance with the Contract Documents.

**8.7 PARTIAL OCCUPANCY OR USE.**

**8.7.1 IN GENERAL**. The DFCM may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is Substantially Complete, provided the DFCM and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of the warranties required by the Contract Documents. When the Contractor considers a portion to be substantially complete, the Contractor shall prepare and submit a list to the A/E as previously provided for herein. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. Contractor shall have continuing responsibility to protect the site and the Work during such partial occupancy and shall be responsible for damage except to the extent caused solely by the DFCM during such partial occupancy or use.

The stage of progress of the Work shall be determined by written agreement between the DFCM and Contractor.

**8.7.2 INSPECTION**. Immediately prior to such partial occupancy or use, the DFCM, Contractor and A/E shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**8.7.3 NOT CONSTITUTE ACCEPTANCE**. Except to the extent it is agreed upon in writing by the DFCM, partial occupancy or use of a portion or portion of the Work shall not constitute acceptance of Work not complying with the requirement of the Contract Documents.

**8.8 FINAL PAYMENT**.

**8.8.1 CERTIFICATE FOR PAYMENT**. The A/E's final Certificate for Payment shall constitute a further representation that the conditions listed in Paragraph 8.8.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**8.8.2 CONDITIONS FOR FINAL PAYMENT**. Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the A/E the following to the extent required by the DFCM Representative:

(1) An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work for which the DFCM or the State of Utah's property might be responsible or encumbered (less amounts

withheld by DFCM) have been paid or otherwise satisfied;

(2) A current or additional certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days prior written notice, by certified mail, return receipt requested, has been given to the DFCM;

(3) A written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents;

(4) If requested by surety in a timely manner or by DFCM, consent of surety, to final payment;

(5) Receipt of Record Drawings, Specifications, Addenda, Change Orders and other Modifications maintained at the site; the warranties, instructions, operation and maintenance manuals, and training videos required to be furnished by the Contract Documents;

(6) Other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the DFCM. If a Subcontractor refuses to furnish a release or waiver required by the DFCM, the DFCM may require consent of Surety to the final payment. If such liens, claims, security interests or encumbrances remain unsatisfied after payments are made, the Contractor shall refund to the DFCM all money that the DFCM may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees; and

(7) A written statement demonstrating how the Contractor will distribute interest earned on retention to Subcontractors as required by Section 13.8.5, U.C.A.

**8.8.3 WAIVER OF CLAIMS: FINAL PAYMENT**. The making of final payment shall constitute a waiver of Claims by the-DFCM except those arising from:

(1) Liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

(2) Failure of the Work to comply with the requirements of the Contract Documents;

(3) Terms of warranties required by the Contract Documents; or

(4) The one-year guaranty period and any corrected Work.

**8.8.4 DELAYS NOT CONTRACTOR'S FAULT**. If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, the DFCM shall, upon application by the Contractor and certification by the A/E, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims. Unless otherwise stated by the DFCM in writing, the making of final payment shall constitute a waiver of claims by the DFCM as provided in Paragraph 8.8.3 for that portion of that Work fully completed and accepted by the DFCM.

**8.8.5 WAIVER BY ACCEPTING FINAL PAYMENT**. Acceptance of final payment by the Contractor or a Subcontractor shall constitute a waiver of Claims by that payee except those Claims previously made in writing and identified by that payee as unsettled at the time of final Application for Payment. Such waivers shall be in addition to the waiver described in Paragraph 8.8.3.

## ARTICLE 9. TESTS AND INSPECTIONS, SUBSTANTIAL AND FINAL COMPLETION, UNCOVERING, CORRECTION OF WORK AND GUARANTY PERIOD.

### 9.1 TESTS AND INSPECTIONS.

**9.1.1 IN GENERAL**. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations, resolutions or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise specifically set forth in the Contract Documents or agreed to by the DFCM in writing, the DFCM shall contract for such tests, inspections and approvals with an independent entity, or with the appropriate public authority, and the DFCM shall bear all related costs of tests, inspections and approvals except as provided below. If any of the Work is required to be inspected or approved by the terms of the Contract Documents or by any public authority, the Contractor shall, at least two working days prior to the time of the desired inspection, and following the procedures established by the DFCM, request such inspection or approval to be performed. The Contractor shall give the A/E timely notice of when and where tests and inspections are to be made so that the A/E may observe such procedures.

**9.1.2 FAILURE OF AN INSPECTOR TO APPEAR**. Work shall not proceed without any required inspection and the associated authorization by DFCM to proceed unless the following procedures and requirements have been met:

(1) The inspection or approval was requested in a timely manner as provided in Paragraph 9.1.1;

(2) The Contractor received written confirmation from the inspection entity that the inspection was scheduled;

(3) The Contractor has contacted or attempted to contact the inspector to confirm that the inspector is unable to perform the inspection as scheduled;

(4) If the inspector has confirmed that it is unable to perform the inspection as scheduled or if the Contractor is unable to contact the inspector, the contractor shall attempt to contact the State Building Official or DFCM Representative for instruction; and

(5) The Contractor has documented the condition of the work prior to being covered through photos or other means.

**9.1.3 NONCONFORMING WORK**. If such procedures for testing, inspection or approval under Paragraph 9.1.1 reveal failure of portions of the Work to comply with the requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the DFCM's expenses, including the cost of retesting for verification of compliance if necessary, until the DFCM accepts the Work in question as complying with the requirements of the Contract Documents.

**9.1.4 CERTIFICATES**. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the A/E.

**9.1.5 A/E OBSERVING**. If the A/E is to observe tests, inspections or approvals required by the Contract Documents, the A/E shall do so with reasonable promptness and, where practicable, at the normal place of testing.

**9.1.6 PROMPTNESS**. Tests, inspections and arrangements for approvals conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

**9.2 INSPECTIONS: SUBSTANTIAL AND FINAL**.

**9.2.1 SUBSTANTIAL COMPLETION INSPECTION**. Prior to requesting a substantial completion inspection, the Contractor shall prepare a comprehensive initial punchlist, including unresolved items from prior inspections, for review by the DFCM and A/E to determine if the Project is ready for a substantial completion inspection. If the DFCM determines that the initial punchlist indicates that the Project is not substantially complete, the initial punchlist will be returned to the Contractor with written comments. If the DFCM determines that the initial punchlist indicates that the Project may be substantially complete, the A/E shall promptly organize and

perform a Substantial Completion inspection in the presence of the DFCM and all appropriate authorities.

(1) If the A/E reasonably determines that the initial punchlist prepared by the Contractor substantially understates the amount of the Work remaining to be completed and the Project is not substantially complete, the A/E shall report this promptly to the DFCM, and upon concurrence of the DFCM, the Contractor will be assessed the costs of the inspection and punchlist preparation incurred by the A/E and the DFCM.

(2) When the Work or designated portion thereof is Substantially Complete, the A/E shall prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion; shall establish responsibilities of the DFCM and Contractor for security, maintenance, heat, utilities, damage to the work and insurance; and shall fix the time within which the Contractor shall finish all items on the punchlist accompanying the Certificate. The Certificate of Substantial Completion shall require approval by the DFCM Representative. If there is a punchlist, the Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on the punchlist does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

(3) Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof except to the extent as provided otherwise in the Contract Documents or if such warranty is related to an item where the work is not complete. Such warranty documents shall state the length of the warranty, which must comply with the Contract Documents.

(4) The Certificate of Substantial Completion shall be submitted by the A/E to the DFCM and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

(5) Except to the extent the DFCM Representative otherwise approves in advance and in writing, the Contractor shall submit the following documents in order to achieve Substantial Completion: written warranties, guarantees, operation and maintenance manuals, and all complete as-built drawings. The Contractor must also provide or obtain any required approvals for occupancy. The Contractor is responsible for the guaranty of all Work, whether performed by it or by its Subcontractors at any tier.

**9.2.2 FINAL COMPLETION INSPECTION**. Prior to requesting a final inspection, the Contractor shall verify all punchlist items are corrected/completed. Once all punchlist items are corrected/completed the Contractor shall notify the DFCM and request a final inspection. The DFCM shall notify the A/E and perform a final inspection. Two final inspections may be allowed due to required weather changes required to complete some items. When all punchlist items are completed a final pay request will be provided by the Contractor, authorized by the A/E and processed by the DFCM.

**9.3 UNCOVERING OF WORK**.

**9.3.1 UNCOVER UNINSPECTED WORK**. Except as provided in Paragraph 9.3.3, if a portion of the Work is covered prior to an Inspector's approval to proceed, it must, be uncovered for the Inspector's inspection and be replaced at the Contractor's expense without change in the Contract Time.

**9.3.2 OBSERVATION PRIOR TO COVERING**. Except as provided in Paragraph 9.3.3, if the DFCM or the A/E has requested in writing to observe conditions prior to any Work being covered or if such observation is specified in the Contract Documents, and the Work is covered without such observation, the Contractor shall be required to uncover and appropriately replace the Work at the Contractor's expense without change in the Contract Time. If the Contractor requests an inspection and the DFCM or A/E, including any inspector of each, does not appear, the Contractor shall immediately notify the DFCM of such lack of appearance, but shall not cover the Work without such inspection.

**9.3.3 WHEN AN INSPECTOR FAILS TO APPEAR OR A/E OR DFCM DID NOT MAKE PRIOR REQUEST**. If Work is performed by the Contractor without an inspection as provided in Paragraph 9.1.2 or if a portion of the Work has been covered which the A/E or DFCM has not specifically requested to observe prior to its being covered or such observation is not specified by the Contract Documents, the A/E or DFCM may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement, shall, by appropriate Change Order, be charged to the DFCM. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the DFCM or a separate contractor in which event the DFCM shall be responsible for payment of such costs.

**9.4 CORRECTION OF WORK AND GUARANTY PERIOD**.

**9.4.1 CONTRACTOR CORRECT THE WORK**. The Contractor shall correct Work rejected by the A/E, Inspector or DFCM, or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear the costs of correcting such rejected Work, including additional testing and inspections and compensation for the A/E's and Inspector's services and expenses made necessary thereby.

**9.4.2 GUARANTY AND CORRECTION AFTER SUBSTANTIAL COMPLETION**. If within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Paragraph 9.2.1 or by terms of an applicable special warranty or guaranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, including failure to perform for its intended purpose, the Contractor shall correct it promptly after receipt of written notice from the DFCM to do so unless the DFCM has previously given the Contractor a written acceptance of such condition. The period of one year shall be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation of the Contractor under this Paragraph 9.4.2 shall be operative notwithstanding the acceptance of the Work under the Contract, the final certificate of payment, partial or total occupancy and/or termination of the Contract. The DFCM shall give notice of observed defects with reasonable promptness, however, failure to give such notice shall not relieve the Contractor of its obligation to correct the Work at the cost that the Contractor would have incurred if the DFCM did so report with reasonable promptness. All corrected Work shall be subject to a one-year guaranty period the same in all respects as the original Work, except that such guaranty period shall commence from the time of Substantial Completion of the corrected Work. This guaranty period does not affect the DFCM's right to pursue any available remedies against Contractor.

**9.4.3 REMOVAL OF WORK**.

(1) The Contractor shall promptly remove from the premises all Work that the DFCM and/or the A/E determines as being in nonconformance with the Contract Documents, whether incorporated or not.

(2) The Contractor shall promptly replace and re-execute the Work in accordance with the Contract Documents and without expense to the DFCM.

(3) The Contractor shall bear the expense of correcting destroyed or damaged construction, whether completed or partially completed, of the DFCM or of other contractors destroyed or damaged by such removal or replacement.

(4) If the Contractor does not remove such rejected Work within a reasonable time, fixed by written notice, the DFCM may have the materials removed and stored at the expense of the Contractor.

(5) If the Contractor does not correct the nonconforming Work within a

reasonable time, fixed by written notice, the DFCM may correct it in accordance with Paragraph 12.2.2 of these General Conditions.

**9.4.4 NOT LIMIT OTHER OBLIGATIONS**. Nothing contained in this Article 9.4 shall be construed to establish a period of limitation with respect to other obligations which the Contractor may have under the Contract Documents. Establishment of the time period of one year as described in Paragraph 9.4.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

**9.5 ADDITIONAL WARRANTIES**.

**9.5.1 IN GENERAL**. In addition to any other provisions of this Article 9, the following warranties shall apply:

(1) The Contractor warrants to the DFCM that materials and equipment furnished under the Contract will be of good quality and new, except to the extent otherwise required or expressly permitted by the Contract Documents.

(2) The Contractor also warrants to the DFCM that the Work will be free from defects not inherent in the quality required or permitted and that the Work will conform with the requirements of the Contract Documents. Work not conforming to said requirements, including substitutions not properly approved and authorized, may be considered defective at the DFCM's option.

**9.5.2 EXCLUSION**. Unless due to the negligent or intentional act or omission of the Contractor or those under the Contractor's control, or as otherwise stated in the Contract Documents, the Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

**9.5.3 FURNISH EVIDENCE ON REQUEST**. If requested by the A/E or DFCM, the Contractor shall furnish satisfactory evidence as to the type and quality of materials and equipment.

9.6 **ACCEPTANCE OF NONCONFORMING WORK**. If the DFCM prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the DFCM may do so in writing instead of requiring its removal and correction, in which case the Contract Sum shall be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## ARTICLE 10. INSURANCE AND BONDS.

**10.1 LIABILITY INSURANCE**.

**10.1.1 IN GENERAL**. To protect against liability, loss and/or expense arising from damage to property or injury or death of any person or persons incurred in any way out of, in connection with or resulting from the Work provided hereunder, Contractor shall obtain and maintain in force during the entire period of this Contract without interruption, at its own expense, the following insurance from insurance companies authorized to do business in the State of Utah in a form and content satisfactory to the DFCM and rated "A-"or better with a financial size category of (a) Class X or larger where the Contract Sum is $1,000,000 or greater or (b) Class VII or larger where the Contract Sum is under $1,000,000. Said rating and financial size category shall be as published by A.M. Best Company at the time the Contract is executed.

(1) Workers' Compensation Insurance and Employers' Liability Insurance. Worker's Compensation Insurance shall cover full liability under the Worker's Compensation Laws of the jurisdiction in which the Project is located at the statutory limits required by said jurisdiction's laws. Employer's Liability Insurance shall provide the following limits of liability: $100,000 for each accident; $500,000 for Disease-Policy Limit; and $100,000 for Disease-Each Employee. The Contractor shall require all Subcontractors to take

and maintain similar policies of Workers' Compensation Insurance.

(2) Commercial General Liability Insurance.

a. Commercial General Liability Insurance, on an "occurrence basis," including insurance for operations, independent contractors, subcontractors at any tier, products/completed operations and contractual liability specifically designating the Indemnity provisions of these General Conditions as an insured contract on the Certificate of Insurance. Such Commercial General Liability Insurance must be endorsed with a Broad Form Property Damage Endorsement (including Completed Operations) and afford coverage for explosion, collapse and underground hazards. Such Commercial General Liability Insurance shall be in limits not less than the following:

$2,000,000 General Aggregate, plus:

i.. If the Construction Value is $25,000,000 or more, an additional $5,000,000 umbrella policy (which covers aggregate and per occurrence) is required; or

ii. if the Construction Value is $10,000,000 or more but less than $25,000,000, an additional $2,000,000 umbrella policy (which covers aggregate and per occurrence) is required.

| | |
|---|---|
| $1,000,000 | Products-Completed Operations Aggregate |
| $1,000,000 | Personal and Advertising Injury |
| $1,000,000 | Each Occurrence |

b. For purposes of this subparagraph 2(a), Construction Value means:

i. the Contract Sum if the work is being performed under a Standard Construction Contractor's Agreement;

ii. the Fixed Limit of Construction Costs if the work is being performed under a Construction Manager/General Contractor Agreement; or

iii. the Guaranteed Fixed contract Amount if the work is to be performed under a Design/Build Agreement.

(3) Automobile liability insurance for claims arising from the ownership, maintenance, or use of a motor vehicle. The insurance shall cover all owned, non-owned, and hired automobiles used in connection with the Work, with the following minimum limits of liability:

$1,000,000 Combined Single Limit Bodily Injury and Property Damage Per Occurrence

(4) Aircraft Use. Contractor using its own aircraft, or employing aircraft in connection with the Work performed under this Agreement shall maintain Aircraft Liability Insurance with a combined single limit of not less than $1,000,000 per occurrence. Said certificate shall state that the policy required by this paragraph has been endorsed to name the State of Utah as Additional Insureds.

(5) Unless otherwise provided by the procurement documents, the insurance requirements in 10.1.1(1) through (4) above do not apply to subcontractors or suppliers at any tier under the Contractor and any insurance requirements of subcontractors and suppliers at any tier is a matter between the General Contractor and such subcontractor or supplier.

**10.1.2 CONFIGURATIONS**. Any policy required by this Article may be arranged under a single policy for the full limit required, or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability Policy.

**10.1.3 CONTRACTOR LIABILITY**. Irrespective of the requirements as to insurance to be carried by Contractor as provided herein; insolvency, bankruptcy or failure of any insurance company to pay all claims accruing, shall not be held to relieve Contractor of any obligations hereunder.

**10.1.4 CERTIFICATE, NOTICE REQUIREMENTS, ADDITIONAL INSURED**. Before the Contract Agreement is executed,

certificates evidencing coverages as specified above are in effect, shall be furnished to the DFCM. Such insurance certificates shall contain provisions that no cancellation, material change therein or non-renewal shall become effective except upon thirty (30) days prior written notice to the DFCM as evidenced by return receipt, certified mail sent to DFCM. The Contractor shall notify the DFCM within thirty (30) days of any claims(s) against the Contractor, and if such claim(s) exceed 20% of the applicable required insured limits, the DFCM may require the Contractor to re-instate the policy to provide full protection at the original limits. For any risk not covered by the Worker's Compensation Policy, the State of Utah shall be named as additional insured parties. All insurance policies provided shall be primary and non-contributing with, and not in excess of, any other insurance or self-insurance available to the State of Utah.

**10.1.5 DEDUCTIBLE LIABILITY**. Any and all deductibles in the above described policies shall be assumed by, for the account of, and at sole risk of Contractor. The allowable deductible for any of the policies required by these General Conditions shall be no more than $1,000 or 0.1 percent of the Contract Amount, whichever is greater. When there is an FLCC, the FLCC shall be the Contract Amount for purposes of calculating the allowable deductible.

**10.1.6 ADDITIONAL REQUIREMENTS:**

(1) Any type of insurance or any increase of limits of liability not described in this Agreement which the Contractor requires for its own protection or on account of any statute, rule or regulation, shall be its own responsibility and at its own expense.

(2) The carrying of any insurance required by this Agreement shall in no way be interpreted as relieving the Contractor or Subcontractors of any other responsibility or liability under this Agreement or any applicable law, statute, rule, regulation or order.

(3) Contractor shall not violate or knowingly permit to be violated any of the provisions of the policies on insurance required under these General Conditions.

**10.2 "BUILDER'S RISK" PROPERTY INSURANCE**.

**10.2.1 IN GENERAL**. The State shall provide "Builder's Risk" property insurance to protect the State, as well as all Contractors and Subcontractors, and include them as insureds, with respect to Work performed hereunder at the State's own cost and expense, according to the policies and forms currently in force with insurance carriers selected by the State's Risk Manager or issued by the State of Utah Risk Management Fund. The State of Utah's Risk Manager shall furnish, upon request, all parties in interest with copies of said policies authenticated by authorized agents of the insurers or the State of Utah's Risk Management Fund.

**10.2.2 INSPECTIONS, RECOMMENDATIONS**. DFCM, the Division of Risk Management and the Builder's Risk insurers shall have the right to inspect the Work. The Contractor shall comply with reasonable risk control recommendations made by insurers or the Division of Risk Management. Such inspections or recommendations do not relieve the Contractor of any of its responsibilities under the Contract Documents.

**10.2.3 DEDUCTIBLE**. The above described "Builders Risk" policies shall be subject to a total deductible of $5,000 per loss occurrence, which shall be assumed by all Contractors or Subcontractors, in proportion to their share of the total amount of an insured loss occurrence.

**10.2.4 ADJUSTED WITH AND PAYABLE TO RISK MANAGER AS TRUSTEE**. Any insured property loss is to be adjusted with the State of Utah Risk Manager, and made payable to the State of Utah Risk Manager as trustee for the Contractor and Subcontractors, as their interests may appear, subject to the requirements of any applicable loss payable clause.

**10.2.5 WAIVER**. Contractor, including all Subcontractors, and DFCM hereby waive all rights against each other for damages caused by

perils insured against under the "Builder's Risk" insurance provided by DFCM, except such rights as Contractor may have to the proceeds of such insurance held by the State of Utah's Risk Manager as trustee. The DFCM and the Contractor each shall require similar waivers from their contractors, subcontractors, subconsultants and agents, at any tier.

**10.2.6 SPECIAL HAZARDS**. DFCM shall bear the risk of loss, delay and/or damage due to earthquake and/or flood and may either insure or self-insure that risk. If the Contractor requests in writing that insurance for other special hazards be included in the "Builder's Risk" policy, the State of Utah's Risk Manager shall, if possible, include such insurance in the policy and the cost thereof shall be charged to the Contractor by Change Order.

**10.3 PERFORMANCE BOND AND PAYMENT BOND**. The Contractor shall submit and maintain in full force and effect as required by law and the Contract Documents, at its own expense, on forms provided by the Division of Facilities Construction and Management, and include as part of the quoted total all costs involved in securing and furnishing, the bonds listed below, based on the completed cost of the Contract and effective upon execution of the Contract. Said bonds shall be from surety companies which are authorized to do business in the State of Utah, listed in the U. S. Department of Treasury Circular 570, Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, and acting within the limitation listed therein.

10.3.1 A full 100 percent performance bond covering the faithful execution of the Contract in accordance with the Contract Documents; and

10.3.2 A full 100 percent payment bond covering payment of all obligations arising under the Contract Documents, for the protection of each person supplying labor, service, equipment, or material for the performance of the Work.

10.3.3 Any required insurance required under the U.S. Terrorism Risk Insurance Act of 2002, any similar applicable law, or as such Act may be amended.

## ARTICLE 11. MISCELLANEOUS PROVISIONS.

**11.1 A/E'S RESPONSIBILITIES.**
These General Conditions are not intended to provide an exhaustive or complete list of the A/E's responsibilities. A separate agreement between the DFCM and A/E incorporates these General Conditions by reference and includes additional Design responsibilities.

**11.2 SUCCESSORS AND ASSIGNS**. The DFCM and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract without the prior written consent of the DFCM, nor shall the Contractor assign any amount due or to become due as well as any rights under the Contract, without prior written consent of the DFCM.

**11.3 WRITTEN NOTICE**.

**11.3.1 PERSONAL DELIVERY AND REGISTERED OR CERTIFIED MAIL**. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail, return receipt requested, to the last business address known to the party giving notice.

**11.3.2 FAX**. Notwithstanding any other provision of these General Conditions, written notice shall also be deemed to have been duly served by verified use of a FAX system by using the known and operative calling number. Service by use of the FAX system is encouraged when timely notice will benefit the–DFCM, A/E or Contractor. Notice shall be considered complete and verified upon the sending and confirmation of delivery using the FAX system, if on the same day notice is also sent by registered or certified mail,

return receipt requested, to the last business address known to the party giving notice, confirming the FAX delivery.

**11.4 RIGHTS AND REMEDIES**.

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

**11.4.2 NOT WAIVER**. Except as expressly provided elsewhere in the Contract Documents, no action or failure to act by the DFCM, A/E or Contractor shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall such action or failure to act constitute approval or acquiescence in a breach thereunder, except as any of the above may be specifically agreed to in writing. In no case shall the Contractor or any Subcontractors be entitled to rely upon any waiver of any of these General Conditions unless agreed to in writing by the DFCM.

**11.5 COMMENCEMENT OF STATUTORY LIMITATION PERIOD.**

**11.5.1 BEFORE SUBSTANTIAL COMPLETION**. Except as provided in 11.5.4 below, as to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion.

**12.5.2 BETWEEN SUBSTANTIAL COMPLETION AND FINAL CERTIFICATION FOR PAYMENT**. Except as provided in Paragraph 11.5.4 below, as to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certification for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certification for Payment.

**11.5.3 AFTER FINAL CERTIFICATION FOR PAYMENT**. Except as provided in Paragraph 11.5.4 below, as to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any guaranty provided under Article 9 the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 9.4.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or DFCM, whichever occurs last.

**11.5.4 EXCEPTION**. Notwithstanding any other provision of this Article 11.5 to the contrary, no applicable statute of limitations shall be deemed to have commenced with respect to any portion of the Work which is not in accordance with the requirements of the Contract Documents, which would not be visible or apparent upon conducting a reasonable investigation, and which is not discovered by the DFCM until after the date which, but for this Paragraph 11.5.4, would be the date of commencement of the applicable statute of limitations; the applicable statute of limitations instead shall be deemed to have commenced on the date of such discovery by the DFCM.

**11.6 NOT DISCRIMINATE, NO SEXUAL HARASSMENT**. Pursuant to the laws of the State of Utah, the Contractor, Subcontractors, or anyone for whose act any of them may be liable, will take affirmative action to not discriminate against any employee or applicant for employment because of race, creed, color, sex, religion, ancestry or national origin. To the extent applicable, said persons will comply with all provisions of Executive Order No. 11246 dated September 24, 1965 and rules, regulations, orders, instructions, designations and other directives promulgated pursuant thereto. Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall not act in any manner as would violate the laws, regulations and policies of the United States or the State of Utah prohibiting sexual harassment.

**11.7 APPLICABLE LAWS.** The applicable laws and regulations of the State of Utah, as well as any applicable local laws and regulations not superseded or exempted by State law, shall govern the execution of the Work embodied in the Contract Documents as well as the interpretation of the Contract Documents.

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

**11.9 VENUE**. In case of any dispute, which may arise under the Contract Documents, the place of venue shall be in the County of Salt Lake, Utah, unless otherwise agreed to by all the parties in writing.

**11.10 SEVERABILITY**. The invalidity of any part, paragraph, subparagraph, phase, provision or aspect of the Contract documents shall not impair or affect in any manner the validity, enforceability or effect of the remainder of the Contract Documents.

**11.11 CONSTRUCTION OF WORDS**. Unless otherwise stated in the Contract Documents, words, which have well-known technical or construction industry meanings, shall be construed as having such recognized meanings. Unless the context requires otherwise, all other technical words shall be construed in accordance with the meaning normally established by the particular, applicable profession or industry. All other words, unless the context requires otherwise, shall be construed with an ordinary, plain meaning.

**11.12 NO THIRD PARTY RIGHTS**. These General Conditions create rights and duties only as between DFCM and Contractor, and DFCM and A/E. Nothing contained herein shall be deemed as creating third party beneficiary contract rights or other actionable rights or duties as between Contractor and A/E, or as between DFCM, Contractor, or A/E on the one hand, and any other person or entity.

## ARTICLE 12. TERMINATION OR SUSPENSION OF THE CONTRACT.

### 12.1 TERMINATION BY CONTRACTOR.

**12.1.1 IN GENERAL**. If the Work is stopped for a period of sixty (60) days through no act or fault of the Contractor or a Subcontractor, or their agents or employees or any other persons performing portions of the Work under contract with any of the above, the Contractor, may terminate the Contract in accordance with 12.1.2 hereinbelow for any of the following reasons:

(1) Because the DFCM has persistently failed to fulfill fundamental DFCM's obligations under the Contract Documents with respect to matters important to the progress of the Work;

(2) Issuance of an order of a court or other public authority having jurisdiction which necessitates such termination, except that where the Contractor has standing, the Contractor must cooperate in efforts to stay and/or appeal such order;

(3) An act of government, such as a declaration of national emergency, making material unavailable; or

(4) Unavoidable casualties or other similar causes as listed in Paragraph 12.2.2(2) hereinbelow.

**12.1.2 NOTICE**. If one of the reasons for termination in Paragraph 12.1.1 hereinabove exist, the Contractor may, upon ten (10) additional days' written notice to the DFCM and A/E, and such condition giving cause for termination still not cured, terminate the Contract and recover from the DFCM payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages associated only with work completed prior to the notice of termination.

### 12.2 TERMINATION BY THE DFCM FOR CAUSE.

**12.2.1 IN GENERAL**. The DFCM Director or Designee may terminate the Contract if the Contractor fails to cure any of the following within a period of ten (10) days (or longer if the DFCM so approves in writing) after receipt of notice from the DFCM specifying the cause for termination:

(1) The Contractor persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

(2) The Contractor fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

(3) The Contractor persistently disregards laws, ordinances, or rules, regulations, resolutions or orders of a public authority having jurisdiction; or

(4) The Contractor fails to perform the Work within the time specified in the Contract Documents or any authorized extension thereof or the Contractor fails to make progress with the Work as to endanger such compliance;

(5) The Contractor fails to perform the Work or is otherwise in breach of a material provision of the Contract Documents;

(6) The Contractor fails to respond promptly to the financial responsibility inquiry under the Contractor's Agreement;

(7) As permissible by law for a reason to terminate, the Contractor is adjudged bankrupt;

(8) As permissible by law for a reason to terminate, the Contractor should make a general assignment for the benefit to creditors;

(9) As permissible by law for a reason to terminate, the Contractor should have a receiver appointed on account of the Contractor's insolvency; or

(10) The Contractor fails to follow the material safety requirements and precautions either as expressly provided in the Contract Documents or as consistent with the customary practices in the industry.

**12.2.2 DFCM'S RIGHT TO CARRY OUT THE WORK**.

(1) If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten (10) day period (or longer if approved by the DFCM in writing) after receipt of written notice from the DFCM to cure such default or neglect, the DFCM may without prejudice to other remedies the DFCM may have, correct such deficiencies, including taking over the Work and prosecuting the same to completion, by contract or otherwise, and may take possession of, and utilize in completing the Work, such materials, appliances, and facilities as may be on the site of the Work as well as the site as necessary for its proper completion. In such case, the DFCM shall offset from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the A/E, DFCM's staff and legal counsel's additional services and expenses made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the DFCM. The Contractor shall continue performance of the Contract to the extent not terminated.

(2) Except with respect to defaults of Subcontractors, the Contractor shall not be liable for any excess costs if the failure to perform the Contract arises out of causes beyond the control and without the fault or negligence of the Contractor or anyone for whom the Contractor may be liable. Such causes may include, but are not limited to, acts of God or of the public enemy, acts of the State of Utah or federal government in either their sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the Contractor or anyone for whom the Contractor may be liable. If the failure to perform is caused by the default of a Subcontractor, and if such default arises out of causes beyond the control of both the Contractor

and the Subcontractor, and without the fault or negligence of either of them or anyone for whom either may be liable, the Contractor shall not be liable for any excess costs for failure to perform unless the supplies or services to be furnished by the Subcontractor were obtainable from other sources in sufficient time to permit the Contractor to meet the required delivery or completion schedule.

**12.2.3 ITEMS REQUIRED TO BE TRANSFERRED OR DELIVERED**. The DFCM may require the Contractor to transfer title and deliver to the DFCM, in the manner and to the extent directed by the DFCM:

(1) Any completed portion of the Work; and

(2) Any partially completed portion of the Work and any parts, tools, dies, jigs, fixtures, drawings, information, and contract rights (hereinafter called "construction materials") as the Contractor has specifically produced or specifically acquired for the performance of such part of this Contract as has been terminated; and the Contractor shall, upon direction of the DFCM, protect and preserve property in the possession of the Contractor in which the DFCM has an interest.

**12.2.4 PAYMENT**. When the DFCM terminates the Contract for one or more of the reasons stated in Paragraph 12.2.1, the DFCM may withhold payment and/or pursue all available remedies.

**12.2.5 DFCM PROTECTION IF LIENABLE**. When the subject property is lienable, the DFCM may withhold from amounts otherwise due the Contractor for such completed Work or construction materials such sum as the DFCM determines to be necessary to protect the State against loss because of outstanding liens or claims for former lien holders.

**12.2.6 CREDITS AND DEFICITS**. If the unpaid balance of the Contract Sum exceeds the full cost of finishing the Work, including compensation for the A/E's services and expenses made necessary thereby, such excess shall be paid to the Contractor. If such cost exceeds the unpaid balance, the Contractor shall pay the difference to the DFCM this obligation for payment shall survive the termination of the Contract.

**12.2.7 IF CONTRACTOR FOUND NOT IN DEFAULT OR EXCUSABLE**. If, after notice of termination of the Contract under the provisions of this Article, it is determined for any reason that the Contractor was not in default under the provisions of this Article, or that the default was excusable under the provisions of this Article, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the termination for convenience provisions.

**12.2.8 RIGHTS AND REMEDIES NOT EXCLUSIVE**. The rights and remedies of the DFCM provided in this Article 12.2 shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

**12.3 SUSPENSION, DELAY OR INTERRUPTION OF WORK BY THE DFCM FOR CONVENIENCE.**

**12.3.1 BY DFCM IN WRITING**. The DFCM may in writing and without cause, order the Contractor to suspend, delay or interrupt the Work in whole or in part for such period of time as the DFCM may determine to be appropriate for the convenience of the DFCM.

**12.3.2 TIME PERIOD FOR CLAIMS**. Any PRE by the Contractor for adjustment under this Article 12.3 must be asserted by the Contractor, in writing, within twenty-one (21) days from the date of termination of such suspension, delay or interruption; provided that the DFCM may, in its sole discretion, receive and act upon any such PRE asserted at any time prior to final payment under this Contract.

**12.3.3 ADJUSTMENTS**. Any adjustment in Contract Sum and Time shall be in accordance with Articles 3, 4, and 7.

**12.4 TERMINATION FOR CONVENIENCE OF THE DFCM.**

**12.4.1 IN GENERAL**.

The performance of Work under this Contract may be terminated by the DFCM in accordance with this Article 12.4 in whole, or from time to time, in part, whenever the DFCM shall determine that such termination is in the best interest of the DFCM or any person for whom the DFCM is acting under this Contract. Any such termination shall be effected by delivery to the Contractor of a notice of termination specifying the extent to which performance of Work under the Contract is terminated, and the date upon which such termination becomes effective.

**12.4.2 CONTRACTOR OBLIGATIONS**. After receipt of a notice of termination, and except as otherwise directed by the DFCM in writing, the Contractor shall:

(1) Stop work under the Contract on the date and to the extent specified in the notice of termination;

(2) Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work under the Contract as is not terminated;

(3) Terminate all orders and subcontracts to the extent that they relate to performance of Work terminated by the notice of termination;

(4) Assign to the DFCM in the manner, at the times, and to the extent directed by the DFCM, all of the right, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the DFCM shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

(5) Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of the DFCM, which approval or ratification shall be final for all the purposes of this Article 12.4;

(6) Transfer title and deliver to the DFCM in the manner, at the times, and to the extent, if any, directed by the DFCM:

(a) The fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced as a part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and

(b) The completed or partially completed drawings, information, and other property which, if the Contract had been completed, would have been required to be furnished to the DFCM;

(7) Use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the DFCM, any property of the types referred to in Paragraph 12.4.2(6) above; provided, however, that the Contractor:

(a) Shall not be required to extend credit to any purchaser; and

(b) May acquire any such property under the conditions prescribed by and at a price or prices approved by the DFCM; and provided further that the proceeds of any such transfer of or disposition shall be applied in reduction of any payments to be made by the DFCM to the Contractor under this Contract or shall otherwise be credited to the price or cost of the Work covered by this Contract or paid in such other manner as the DFCM may direct;

(8) Complete performance of such part of the Work as shall not have been terminated by the notice of termination; and

(9) Take such action as may be necessary, or as the DFCM may direct, for the protection and preservation of the property related to this Contract which is in the possession of the Contractor in which the State has or may acquire an interest.

**12.4.3 TERMINATION CLAIM**. After receipt of a notice of termination, the Contractor may submit to the DFCM a PRE, in the form and with certification prescribed by the DFCM. Such PRE shall be submitted promptly

but in no event not later than sixty (60) days from the effective date of termination.

**12.4.4 AGREED UPON PAYMENT**. Subject to the provisions of Paragraph 12.4.3 above, the Contractor and the DFCM may agree upon the amount to be paid to the Contractor by reason of the total or partial termination of Work pursuant to this Article 12.4.

**12.4.5 PAYMENT NOT AGREED UPON**. In the event of the failure of the Contractor and the DFCM to agree, as provided in Paragraph 12.4.4, upon the whole amount to be paid to the Contractor by reason of the termination of Work pursuant to this Article 12.4, the DFCM shall pay to the Contractor the amounts determined by the DFCM as follows, but without duplication of any amounts agreed upon in accordance with Paragraph 12.4.4:

(1) With respect to all Contract Work performed prior to effective date of the notice of termination, the total (without duplication of any items) of:

(a) The cost of such Work including undisputed Claim amounts;

(b) The cost of terminating, settling and paying claims arising out of the termination of Work under subcontracts or orders as provided in Paragraph 12.4.2(5) above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by Subcontractors prior to the effective date of the notice of termination under this Contract, which amounts shall be included in the cost on account of which payment is made under Paragraph 12.4.5(1)(a) above;

(c) A sum, as overhead and profit on Paragraph 12.4.5(1)(a) above, determined by the DFCM to be fair and reasonable;

(d) The reasonable cost of the preservation and protection of property incurred pursuant to Paragraph 12.4.2(9); and any other reasonable cost incidental to termination of Work under this Contract, including expenses incidental to the determination of the amount due to the Contractor as the result of the termination of Work under this Contract.

(2) The total sum to be paid to the Contractor under Paragraph 12.4.5(1) above shall not exceed the total Contract Sum as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. Except for normal spoilage, and except to the extent that the DFCM shall have otherwise expressly assumed the risk of loss in writing, there shall be excluded from the amounts payable to the Contractor under Paragraph 12.4.5(1) above, the fair value of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the DFCM, or to a buyer pursuant to Paragraph 12.4.2(7).

**12.4.6 DEDUCTIONS**. In arriving at the amount due the Contractor under this Article 12.4, there shall be deducted:

(1) All unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of this Contract;

(2) Any Claim which the State may have against the Contractor in connection with this Contract; and

(3) The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by the Contractor or sold, pursuant to the provisions of this Article 13.4, and not otherwise recovered by or credited to the DFCM.

**12.4.7 PARTIAL TERMINATION**. If the termination is partial, the Contractor may file with the DFCM a PRE for the amounts specified in the Contract relating to the continued portion of the Contract and such equitable adjustment as may be agreed upon shall be made in such amounts. Any PRE under this Paragraph 12.4.7 must be filed within twenty-one (21) days from the effective date of the notice of termination.

**12.4.8 PARTIAL PAYMENTS**. The DFCM may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs

incurred by the Contractor in connection with the terminated portion of this Contract whenever, in the opinion of the DFCM the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Article 12.4, such excess shall be payable by the Contractor to the DFCM upon demand, together with interest at a rate equal to the average rate at the time being received from the investment of state funds, as determined by the State Treasurer, for the period until the date such excess is repaid to the DFCM; provided, however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in the Contractor's claim by reason of retention or other disposition of termination inventory until ten (10) days after the date of such retention or disposition, or such later date as determined by the DFCM by reason of the circumstances.

**12.4.9 PRESERVE AND MAKE AVAILABLE RECORDS**. Unless otherwise provided for in this Contract, or by applicable law, the Contractor shall, from the effective date of termination until the expiration of three years after final settlement under this Contract, preserve and make available to the DFCM at all reasonable times at the office of the Contractor, but without direct charge to the DFCM, all books, records, documents and other evidence bearing on the costs and expenses of the Contractor under this Contract and relating to the Work terminated hereunder, or, to the extent approved by the DFCM Representative, photographs, micrographs, or other authentic reproductions thereof.

**12.5 DFCM'S RIGHT TO STOP THE WORK**. If the Contractor fails to correct Work or fails to carry our Work, as required by the Contract Documents or fails to comply with all required and customary safety precautions; the DFCM, by written order signed personally or by an agent specifically so empowered by the DFCM in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the DFCM to stop the Work shall not give rise to a duty on the part of the DFCM to exercise this right for the benefit of the Contractor or any other person or entity.

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# SUPPLEMENTAL GENERAL CONDITIONS FOR CONSTRUCTION AGREEMENTS

July 15, 2008

**Article 1. Intent and Purpose: Senate Bill 220 – 2008.**
The 2008 Utah Legislature passed Senate Bill 220 entitled "Cause of Action for Defective Construction" which law became effective May 5, 2008 (hereinafter "SB220"). The intent purpose of Article 1 through 3 of these Supplement General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bill.

**Article 2. "Entities under the Contractor"** shall mean any and all agents, independent contractors, subcontractors, suppliers, manufacturers and providers at every tier under the General Contractor.

**Article 3. General Provisions**

**3.1 Conditions.** The General Conditions impose duties and performance obligations on the parties. This includes, but is not limited to, the provisions of Article 5.2.1 (regarding subcontractor's compliance with Contract Documents), Article 4.13 (indemnification which discusses acts, omissions, and negligence responsibility) and other provisions of the General Conditions which list many performance obligations of the General Contractor and those under the General Contractor.

**3.2 Third Party Beneficiary.** The State of Utah and DFCM shall be an intended third party beneficiary to all contracts entered into with Entities under the Contractor. Upon written request by DFCM, DFCM shall be entitled to obtain copies of all such contracts. The General Contractor shall be responsible for assuring that all such third party beneficiary agreements are in place and shall bear the responsibility for any lack of required language in any contracts with an Entity under the Contractor which does not contain this required provision.

**3.3 "Economic Loss Rule."** The "Economic Loss Rule" as it has been referred to in Utah law shall be deemed to be interpreted in accordance with prevailing Utah law.

**3.4 Toxic Torts.** "Defective Construction" for purposes of any limitation of any cause of action or right as contemplated by SB220 does not, under these Supplemental General Conditions and for purposes of any Entities under the Contractor, include the use or installing of a defective or inherently dangerous, hazardous or toxic product, substance, or material. The State has third party beneficiary rights and other rights allowed by law to pursue a direct cause of action against the manufacturer and/or distributor of such defective or inherently dangerous, hazardous or toxic product, substance or material, except that the General Contractor and other subcontractors, exclusive of manufacturers and distributors, under the General Contractor shall not be responsible to the State of Utah for said "product, substance or material" unless the General Contractor or such subcontractor knew or should reasonably have known that the product, substance or material was defective or inherently dangerous, hazardous or toxic at the time it was provided or installed on the Project.

**3.5 Subsection 3 of SB 220.** For purposes of Subsection (3) of SB 220, the phrase "property damage" shall be deemed to refer to damage to "other property" meaning property that is other than the exact specific construction defect itself.

**3.6 "Failure of the Construction to Function as Designed."** The language "failure to function as designed" as used in SB 220 shall not be deemed to refer to the failure of the construction to be constructed in accordance with the Contract Documents.

**3.7 Independent Duty.** The State of Utah and DFCM maintain the right to pursue a cause of action against the General Contractor and directly against any Entities under the Contractor, for violation of any independent duty owed to the State of Utah or DFCM.

**3.8 Not create Contract Right by Entity under the Contractor with State of Utah or DFCM.** These Supplemental General Conditions shall not be construed in any manner which would create a contract between the State of Utah/DFCM and any Entity under the Contractor, except for the Third Party Beneficiary rights of the State of Utah/DFCM provided herein. Any pursuit of a claim by an Entity under the Contractor, including payment claims, shall be maintained either against the payment bond or the upper tier Contractor in accordance with Utah law.

## Article 4. Warranties and Obligations

Every Entity under the Contractor has an obligation to comply with the requirements of this Contract, including the indemnification of the Owner for negligent or intentional construction defects and to provide materials and construction that meets all express or implied warranties under the Uniform Commercial Code, including fitness for a particular purpose, merchantability, workmanlike construction (work completed in a skillful manner and is non-defective) and habitability, and is performed with the reasonable care to protect persons and property. In regard to toxic, hazardous materials and other matters of construction where applicable statutory and case law allows, strict liability shall apply.

# SUPPLEMENTAL GENERAL CONDITIONS FOR DESIGN AGREEMENTS

July 15, 2008

**Article 1. Intent and Purpose: Senate Bill 220 – 2008.**
The 2008 Utah Legislature passed Senate Bill 220 entitled "Cause of Action for Defective Construction" which law became effective May 5, 2008 (hereinafter "SB220"). The intent purpose of these Supplement General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bill.

**Article 2. "Entities under the Designer"** shall mean any and all agents, independent contractors, consultants, subconsultants, subcontractors, suppliers, manufacturers and providers at every tier under the Designer.

**Article 3. General Provisions**

**3.1 Design Agreement.** The Design Agreement for the subject Project imposes duties and performance obligations on the parties. This includes, but is not limited to, the standard of care provisions provided in said Design Agreement.

**3.2 Third Party Beneficiary.** The State of Utah and DFCM shall be a third party beneficiary to all contracts entered into with Entities under the Designer. Upon written request by DFCM, DFCM shall be entitled to obtain copies of all such contracts. The Designer shall be responsible for assuring that all such third party beneficiary agreements are in place and shall bear the responsibility for any lack of required language in any contracts with an Entity under the Designer which does not contain this required provision.

**3.3. "Economic Loss Rule."** The "Economic Loss Rule" as it has been referred to in Utah law shall be deemed to be interpreted in accordance with prevailing Utah law.

**3.4 Toxic Torts.** "Defective Construction" for purposes of any limitation of any cause of action or right as contemplated by SB220 does not, under these Supplemental General Conditions and for purposes of any Entities under the Designer, include the use or installing of a defective or inherently dangerous,

hazardous or toxic product, substance, or material. The State has third party beneficiary rights and other rights allowed by law to pursue a direct cause of action against the manufacturer and/or distributor of such defective or inherently dangerous, hazardous or toxic product, substance or material, except that the Designer and other consultants/subconsultants under the Designer, exclusive of manufacturers and distributors, shall not be responsible to the State of Utah for said "product, substance or material" unless the Designer or such consultants/subconsultants knew or should reasonably have known that the product, substance or material was defective or inherently dangerous, hazardous or toxic at the time it was made a part of the Contract Documents by the Designer.

**3.5 Subsection 3 of SB 220.** For purposes of Subsection (3) of SB 220, the phrase "property damage" shall be deemed to refer to damage to "other property" meaning property that is other than the exact specific construction defect itself.

**3.6 "Failure of the Construction to Function as Designed."** The language "failure to function as designed" as used in SB 220 shall not be deemed to refer to the failure of the construction to be constructed in accordance with the Contract Documents.

**3.7 Independent Duty.** The State of Utah and DFCM maintain the right to pursue a cause of action against the Designer and directly against any Entities under the Designer, for violation of any independent duty owed to the State of Utah or DFCM.

**3.8 Not create Contract Right by Entity under the Designer with State of Utah or DFCM.** These Supplemental General Conditions shall not be construed in any manner which would create a contract between the State of Utah/DFCM and any Entity under the Designer, except for the Third Party Beneficiary rights of the State of Utah/DFCM provided herein. Any pursuit of a claim by an Entity under the Designer, including payment claims, shall be maintained against the upper tier entity in accordance with Utah law

# SUPPLEMENTAL GENERAL CONDITIONS FOR DRUG AND ALCOHOL TESTING DESIGN AND/OR CONSTRUCTION CONTRACTS

July 1, 2010

1. These Supplemental General Conditions shall only apply to design or construction contracts in compliance with UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7. (Note: the Administrative Rule is anticipated to have an effective date in early July, 2010 and will upon its being effective apply to those design and construction contracts issued on or after July 1, 2010, and the Statute itself is effective on July 1, 2010.) All applicable provisions of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 are incorporated herein by reference as if fully set forth herein. The provisions below provide some, but not all of the provisions of said statute and administrative rule. The absence of the recitation of a provision of UCA Section 63G-6-604 or Utah Administrative Code Rule R23-7 below, shall not lesson its importance. Contractors and Designers are encouraged to read the complete UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 in order to assure compliance with all the applicable provisions.

2. Definitions. For the purpose of these Supplemental General Conditions, the definitions in UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 shall apply. For convenience, the following definitions are provided below:

a. **"Contractor" for purposes of these Supplemental General Conditions includes the Prime Contractor, a Designer (Architect/Engineer), and any of their subcontractors, consultants or subconsultants at any tier involved in design and/or construction. "Contractor" for purposes of these Supplemental General Conditions does not include a supplier who provide only materials, equipment or supplies to a Contractor, Designer or any of their subcontractors, consultants or subconsultants at any tier.**

b. "Covered Individual" means an individual who: (i) on behalf of the Contractor provides services directly related to design or construction under the contract; and (ii) is in a safety sensitive position, including a design position that has responsibilities that directly affect the safety of an improvement to real property that is the subject of a state construction contract

3. Contractor shall have a drug and alcohol testing policy in accordance with UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 during the period of the contract that applies to the "Covered Individuals" hired by the Contractor. Contractor shall post in one or more conspicuous places notice

to "Covered Individuals" hired by the Contractor that the Contractor has the drug and alcohol testing policy described in UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7-4(1)(a)(i). Said "Covered Individuals" shall be subject to random drug and alcohol testing under said policy if at any time during the period of the contract there are ten (10) or more "Covered Individuals" hired by the Contractor.

4. Contractor hereby certifies the following:

a. By executing this Contract, that the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above, shall comply with all provisions of Utah Administrative Code Rule R23-7 as well as UCA 63G-6-604, including having and maintaining a drug and alcohol testing policy, the posting and random testing requirements during the period of the contract that applies to Covered Individuals hired by the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above;

b. That the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above, shall have these requirements placed in all subcontracts for design or construction at any tier, in order that all such subcontractors, consultants and subconsultants at any tier have notice of these requirements and understand the need for compliance with these requirements;

c. That the subcontractors, consultants and subconsultants at any tier referred to in paragraph 4.b. above shall comply with the same requirements as the Contractor for having and maintaining a drug and alcohol testing policy, the posting and random testing requirements during the period of their contract;

d. That the Contractor, or any entity included in the definition of Contractor in paragraph 2.a. above may be suspended or debarred in accordance with the Utah Procurement Code for failure to comply as provided in UCA Section 63G-6-604(3)(a) and Utah Administrative Code Rule R23-7-4(3)(b); and

e. That the prime contactor or prime designer shall on a semi-annual basis throughout the term of this Contract, report to the Division in writing, information that indicates compliance with the provisions of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7.

5. Reasonable notice and an opportunity to cure any violation of UCA 63G-6-604 shall be provided to the Contractor before any suspension or debarment may be undertaken by the Division against the Contractor in light of the circumstances of the Contract or the violation. The greater the risk to person(s) or property as a result of noncompliance, the shorter this notice and opportunity to cure shall be, including the possibility that the notice may provide for immediate compliance if necessary to protect person(s) or property.

6. If a Contractor meets the requirements of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7, said statute and rule may not be construed to restrict the Contractor's ability to impose or implement an otherwise lawful provision as part of a drug and alcohol testing policy.

# SUPPLEMENTAL GENERAL CONDITIONS REGARDING ILLEGAL IMMIGRATION

May 10, 2011

**Article 1. Intent and Purpose. Senate Bill 81 modified by Senate Bill 39 – 2009.** The 2009 Utah Legislature passed Senate Bills 81 and 39 regarding "**Illegal Immigration**" which laws became effective July 1, 2009 (hereinafter "SB81/39"). The 2011 Utah Legislature made further amendments that relate to this document in HB 116. These bills deal with provisions related to the immigration status of individuals within the state. The intent of Articles 1 through 3 of these Supplemental General Conditions is to provide the necessary provisions to the General Conditions as a result of such bills.

**Article 2. Applicability.** These "Supplemental General Conditions for Illegal Immigration" under SB 39 of the 2009 Utah General Legislative Session and HB 116 of the 2011 Utah General Legislative Session, only applies to Request for Proposals and includes sole sources that are part of Requests for Proposals. However, all entities under contract with DFCM as well as all others that are subject to applicable immigration laws, including their subcontractors/subconsultants, at any tier, shall comply with all applicable immigration laws. This document does not apply to procurements that are done by the Competitive Sealed Bidding process (often referred to as "low-bid"), the Multi-Step Process, direct awards, sole sources awards that are not part of Requests for Proposals, and emergency procurements. This document also does not apply to good faith contract modifications to contracts that existed prior to July 1, 2009.

There is a Program Start Date defined in said HB 116 of the 2011 Utah General Legislative Session. At such time that knowledge is obtained about when that Program Start Date is, DFCM will post an amendment to this "Supplemental General Conditions Regarding Illegal Immigration."

**Article 3. E-Verify Clause.** Certify registration and use of employment "Status Verification System".

3.1 Each offeror and each person signing on behalf of any offeror certifies as to its own entity, under penalty of perjury, that the named Contractor has registered and is participating in the Status Verification System to verify the work eligibility status of the Contractor's new employees that are employed in the State of Utah in accordance with 63G-12-302 as described in HB 116 of the 2011 Utah General Legislative Session. *(A copy of 63G-12-302 is provided at the end of this document for your convenience.)*

3.2 The Contractor shall require that the following provision be placed in each subcontract at every tier: "The subcontractor shall certify to the main (prime or general) contractor by affidavit that the subcontractor has verified through the Status Verification System the employment status of each

new employee of the respective subcontractor, all in accordance with Section 63G-11-103 and to comply with all applicable employee status verification laws. Such affidavit must be provided prior to the notice to proceed for the subcontractor to perform the work."

3.3 The State of Utah or DFCM will not consider a proposal for award, nor will it make any award where there has not been compliance with this Article.

3.4 Manually or electronically signing the Proposal is deemed the Contractor's certification of compliance with all provisions of this employment status verification certification required by all applicable status verification laws including UCA Section 63G-12-302 as described in HB 116 of the 2011 Utah General Legislative Session. *(A copy of 63G-12-302 is provided at the end of this document for your convenience.)*

**Article 4. Indemnity**

4.1 Contractor (includes, but is not limited to any Contractor, Design Professional, Designer or Consultant) shall protect, indemnify and hold harmless, the State of Utah, the DFCM and its officers, employees, agents, representatives and anyone that the State of Utah or the DFCM may be liable for, against any claim, damages or liability arising out of or resulting from violations of these Supplemental General Conditions Regarding Illegal Immigration whether violated by employees, agents, or contractors of the following:

4.1.1 Contractor;
4.1.2. Subcontractor at any tier; and/or
4.1.3 any entity or person for whom the Contractor or Subcontractor may be liable.

4.2 Notwithstanding 4.1 above, Design Professionals or Designers under direct contract with the DFCM shall only be required to indemnify the State of Utah or the DFCM for a liability claim that arises out of the design professional's services, unless the liability claim arises from the Design Professional's negligent act, wrongful act, error or omission, or other liability imposed by law except that the Design Professional shall be required to indemnify the State of Utah or the DFCM in regard to subcontractors or subconsultants at any tier that are under the direct or indirect control or responsibility of the Design Professional, and includes all independent contractors, agents, employees or anyone else for whom the Design Professional may be liable at any tier.

*** The following is provided for your convenience: Note: The definitions of "Public Employer," "Status Verification System," "Unauthorized Alien," and "Program Start Date" as well as other relevant definitions are located in Section 63G-12-102. Other provisions of Utah Code Title 63G, Chapter 12, should be read as well as all applicable immigration laws.)**

**63G-12-302. Status verification system -- Registration and use -- Performance of services -- Unlawful practice.**

(1) As used in this section:

(a) "Contract" means an agreement for the procurement of goods or services that is awarded through a request for proposals process with a public employer and includes a sole source contract.

(b) "Contractor" means a subcontractor, contract employee, staffing agency, or any contractor regardless of its tier.

(2) (a) Subject to Subsection (5), a public employer shall register with and use a Status Verification System to verify the federal employment authorization status of a new employee.

(b) This section shall be enforced without regard to race, religion, gender, ethnicity, or national origin.

(3) (a) Subject to Subsection (5), beginning July 1, 2009:

(i) a public employer may not enter into a contract for the physical performance of services within the state with a contractor unless the contractor registers and participates in the Status Verification System to verify the work eligibility status of the contractor's new employees that are employed in the state; and

(ii) a contractor shall register and participate in the Status Verification System in order to enter into a contract with a public employer.

(b) (i) For purposes of compliance with Subsection (3)(a), a contractor is individually responsible for verifying the employment status of only new employees who work under the contractor's supervision or direction and not those who work for another contractor or subcontractor, except as otherwise provided in Subsection (3)(b)(ii).

(ii) Each contractor or subcontractor who works under or for another contractor shall certify to the main contractor by affidavit that the contractor or subcontractor has verified through the Status Verification System the employment status of each new employee of the respective contractor or subcontractor.

(c) Subsection (3)(a) does not apply to a contract:

(i) entered into by the entities referred to in Subsection (3)(a) prior to July 1, 2009, even though the contract may involve the physical performance of services within the state on or after July 1, 2009; or

(ii) that involves underwriting, remarketing, broker-dealer activities, securities placement, investment advisory, financial advisory, or other financial or investment banking services.

(4) (a) It is unlawful for an employing entity in the state to discharge an employee working in Utah who is a United States citizen or permanent resident alien and replace the employee with, or have the employee's duties assumed by, an employee who:

(i) the employing entity knows, or reasonably should have known, is an unauthorized alien hired on or after July 1, 2009; and

(ii) is working in the state in a job category:

(A) that requires equal skill, effort, and responsibility; and

(B) which is performed under similar working conditions, as defined in 29 U.S.C., Sec. 206 (d)(1), as the job category held by the discharged employee.

(b) An employing entity, which on the date of a discharge in question referred to in Subsection (4)(a) is enrolled in and using the Status Verification System to verify the

employment eligibility of its employees in Utah who are hired on or after July 1, 2009, is exempt from liability, investigation, or lawsuit arising from an action under this section.

(c) A cause of action for a violation of this Subsection (4) arises exclusively from the provisions of this Subsection (4).

(5) On and after the program start date:

(a) a public employer, after hiring an employee, shall verify the employment eligibility of the new employee:

(i) through the status verification system if the individual does not hold a permit; and

(ii) through the u-verify program if the individual holds a permit; and

(b) a contractor is considered to be in compliance with this section if, after hiring an employee, the contractor verifies the employment eligibility of the new employee:

(i) through the status verification system if the individual does not hold a permit; and

(ii) through the u-verify program if the individual holds a permit.

Renumbered and Amended by Chapter 18, 2011 General Session

# SUPPLEMENTAL GENERAL CONDITIONS FOR HEALTH INSURANCE

Effective May 10, 2011

**Article 1 Intent and Purpose. House Bill 331 – 2009.** The 2009 Utah Legislature passed House Bill 331 entitled "**Health Reform – Health Insurance Coverage in State Contracts**" which law became effective July 1, 2009 (hereinafter "HB331"). This bill has been amended by HB20 of the 2010 Utah Legislative Session as well as HB 128 of the 2011 Utah Legislative Session. These laws require certain state entities to require a contractor who contracts with the state entity to offer the contractor's employees qualified health insurance coverage as defined in Utah Code Annotated 26-40-115, and further defined on the DFCM website at *http://dfcm.utah.gov/downloads/Health%20Insurance%20Benchmark.pdf* during the duration of the contract if the contract is over a certain amount, and if the contract is a construction and/or or design contract. The intent of the Articles of these Supplemental General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bills. The purpose of this Article is to comply with UCA Section 63A-5-205 as well as Utah Code Administrative Rule R23-23 which are both hereby incorporated by reference herein.

**Article 2. Applicability of this Article.** This Article only applies to those contracts as required by UCA Section 63A-5-205 as well as Utah Code Administrative Rule R23-23. In case of conflict, UCA Section 63A-5-205 supersedes Rule R23-23. As stated in Rule R23-23-4:

*((1) Except as provided in Rule R23-23-4(2) below, this Rule R23-23 applies to all design or construction contracts entered into by the Division or the Board on or after July 1, 2009, and*

*(a) applies to a prime contractor if the prime contract is in the amount of $1,500,000 or greater; and*

*(b) applies to a subcontractor if the subcontract is in the amount of $750,000 or greater.*

*(2) This Rule R23-23 does not apply if:*

*(a) the application of this Rule R23-23 jeopardizes the receipt of federal funds;*

*(b) the contract is a sole source contract; or*

*(c) the contract is an emergency procurement.*

*(3) This Rule R23-23 does not apply to a change order as defined in Section 63G-6-103, or a modification to a contract, when the contract does not meet the initial threshold required by Rule R23-23-4(1).*
*(4) A person who intentionally uses change orders or contract modifications to circumvent the requirements of subsection (1) is guilty of an infraction.*
*(**Note**: "Subcontractor" includes subcontractors at any tier that meet the definition provided in UCA Section 63A-5-208.)*

**Article 3. Definitions.** The following definitions apply to this Article:
3.1 "Contractor" means the person/entity under direct contract with the Division herein. If the direct contract includes a Design Professional, then the Design Professional is a "Contractor" for purposes of this Article.
3.2 "Design Professional" means the Architect or Engineer, its Subconsultants or Subcontractors at any tier, or any of their agents, employees, including those employed directly or indirectly, or other persons or entities for whose acts the Design Professional or its Subconsultants/Subcontractors at any tier may be liable.
3.3 "Employee(s)" means an "employee." "worker" or "operative" as defined in Utah Code Annotated S34A-2-104 who:

(i) works at least 30 hours per calendar week; and

(ii) meets employer eligibility waiting requirements for health care insurance which may not exceed the first day of the calendar month following 90 days from the date of hire.

3.4 "State" means the State of Utah.
3.5 "Director" includes an authorized designee of the Director.

**Article 4. Health Insurance Certification.** Contractor hereby certifies that the Contractor and all applicable subcontractors and subconsultants at any tier that is subject to UCA 63A-5-205 and Utah Administrative Code Rule R23-23, has and will maintain for the duration of this contract, an offer of qualified health insurance coverage for their employees; all in accordance with UCA 63A-5-205, and Utah Administrative Code Rule R23-23.

Rule R-23-23-7
(1) through (7) as well as Rule R23-23-8 indicate the following:
***R23-23-7. Requirements and Procedures a Contractor Must Follow.***
*A contractor (including consultants and designers) must comply with the following requirements and procedures in order to demonstrate compliance with Section 63A-5-205.*
*(1) Demonstrating Compliance with Health Insurance Requirements. The following requirements must be met by a contractor (including consultants, designers and others under contract with the Division)*

*that is subject to the requirements of this Rule no later than the time the contract is entered into or renewed:*
*(a) demonstrate compliance by a written certification to the Director that the contractor has and will maintain for the duration of the contract an offer of qualified health insurance coverage for the contractor's employees and the employee's dependents; and*
*(b) The contractor shall also provide such written certification prior to the execution of the contract, in regard to all subcontractors (including subconsultants) at any tier that is subject to the requirements of this*
*Rule.*
*(2) Recertification. The Director shall have the right to request a recertification by the contractor by submitting a written request to the contractor, and the contractor shall so comply with the written request within ten (10) working days of receipt of the written request; however, in no case may the contractor be required to demonstrate such compliance more than twice in any 12-month period.*
*(3) Demonstrating Compliance with Actuarially Equivalent Determination. The actuarially equivalent determination required by Subsection 63A-5-205(1)(e) is met by the contractor if the contractor provides the Director with a written statement of actuarial equivalency from either the Utah Insurance Department; an actuary selected by the contractor or the contractor's insurer; or an underwriter*
*who is responsible for developing the employer group's premium rates.*
*For purposes of this Rule R23-23-7(3), actuarially equivalency is achieved by meeting or exceeding The requirements of Section 26-40-115 which are also delineated on the DFCM website at http://dfcm.utah.gov/downloads/Health%20Insurance%20Benchmark.pdf .*
*(4) The health insurance must be available upon the first day of the calendar month following ninety (90) days from the date of hire.*
*(5) Architect and Engineer Compliance Process. Architects and engineers that are subject to this Rule must demonstrate compliance with this Rule in any annual submittal under Section 63G-6-702. During the procurement process and no later than the execution of the contract with the architect or engineer, the architect or engineer shall confirm that their applicable subcontractors or subconsultants meet the requirements of this Rule.*
*(6) General (Prime) Contractors Compliance Process. Contractors that are subject to this Rule must demonstrate compliance with this Rule for their own firm and any applicable subcontractors, in any prequalification process that may be used for the procurement. At the time of execution of the contract, the contractor shall confirm that their applicable subcontractors or subconsultants meet the requirements of this Rule.*
*(7) Notwithstanding any prequalification process, any contract subject to this Rule shall contain a provision requiring compliance with this Rule from the time of execution and throughout the duration of the contract.*
*(8) Hearing and Penalties.*
*(a) Hearing. Any hearing for any penalty under this Rule conducted by the Board or the Division shall be conducted in the same manner as any hearing required for a suspension or debarment.*
*(b) Penalties that may be imposed by Board or Division. The penalties that may be imposed by the Board or the Division if a contractor, consultant, subcontractor or subconsultant, at any tier, intentionally violates the provisions of this Rule R23-23, may include:*
*(i) a three-month suspension of the contractor or subcontractor from entering into future contracts with the State upon the first violation, regardless of which tier the contractor or subcontractor is involved with the future design and/or construction contract;*
*(ii) a six-month suspension of the contractor or subcontractor from entering into future contracts with the State upon the second violation, regardless of which tier the contractor or subcontractor is involved with the future design and/or construction contract;*
*(iii) an action for debarment of the contractor or subcontractor in accordance with Section 63G-6-804 upon the third or subsequent violation; and*

*(iv) monetary penalties which may not exceed 50 percent of the amount necessary to purchase qualified health insurance coverage for an employee and the dependents of an employee of the contractor or subcontractor who was not offered qualified health insurance coverage during the duration of the contract.*

*(c)(i) In addition to the penalties imposed above, a contractor, consultant, subcontractor or subconsultant who intentionally violates the provisions of this Rule shall be liable to the employee for health care costs that would have been covered by qualified health insurance coverage.*

***R23-23-8. Not Create any Contractual relationship with any Subcontractor or Subconsultant.***

*Nothing in this Rule shall be construed as to create any contractual relationship whatsoever between the State of Utah, the Board, or the division with any subcontractor or subconsultant at any tier.*

| BENEFITS Benchmark effective May 10, 2011 | PARTICIPATING BENEFITS | NONPARTICIPATING BENEFITS |
|---|---|---|
| **Deductible and Out-of-Pocket Maximum** | | |
| Deductible (Single/Family) | $1,000/$3,000 | $1,000/$3,000 |
| Out-of-Pocket Maximum (Single/Family) | $3,000/$9,000 | $3,000/$9,000 |
| Dental Coverage is not required | | |
| **Coinsurance and Copay** | | |
| Coinsurance (e.g., Inpatient, outpatient) | 20% after ded | 40% after ded |
| Office Visit (PCP/SCP) | $25/$40 | 40% after ded |
| Participating Emergency Room Visit | $250 after ded | See "Participating Benefits" |
| Nonparticipating Emergency Room Visit | $250 after ded | See "Participating Benefits" |
| **Lifetime Maximum Plan Payment** | None | None |
| **Pre-existing Conditions (Members 19 and older)** | | |
| Waived (entirely or partly) for qualifying pre-existing condition credit | Not covered for first 12 months | Not covered for first 12 months |
| **Professional Services** | | |
| Immunizations | Covered 100% | Not covered |
| Elective Immunizations | 20% after ded | Not covered |
| Preventive | 100% | Not covered |
| **Outpatient Services** | | |
| Instacare/Urgent Care | $40 | 40% after ded |
| Kidscare | $25 | Not available |
| Diagnostic Tests, Minor | Covered 100% | 40% after ded |
| Diagnostic Tests, Major | 20% after ded | 40% after ded |
| Physical, Speech, and Occupational Therapy (limited to 20 visits per calendar year) | $40 copay after ded | 40% after ded |
| **Mental Health and Chemical Dependency** | 50% after ded | 50% after ded |
| Not applied to the out-of-pocket maximum | | |
| Inpatient limited to 10 days/calendar year | | |
| Outpatient limited to 25 visits/calendar year | | |
| **Miscellaneous Services** | | |
| Maternity and Adoption | 20% after ded | 40% after ded |
| Infertility ($1,500/calendar year; $5,000/lifetime) | 50% after ded | Not Covered |
| Chiropractic (limited to 15 visits/calendar year) | Not available | 50% after ded |
| **Prescription Drugs** | | |
| Rx Deductible (Single) | None | See "Participating Benefits" |
| Rx Out-of-Pocket Maximum (Single) | $4,000 | See "Participating Benefits" |
| Up to a 30-day supply for covered medications; generic substitution required; same copay or coinsurance applies to a 90-day maintenance home delivery supply | Tier1: $10<br>Tier 2: 25%<br>Tier 3: 50% | Tier1: $10<br>Tier 2: 25%<br>Tier 3: 50% |

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# DIVISION 1 - GENERAL REQUIREMENTS


| | |
|---|---|
| Section 01 1000 | Summary of Work |
| Section 01 1900 | Definitions and Standards |
| Section 01 2300 | Alternates |
| Section 01 2605 | Contract Modification Procedures |
| Section 01 2900 | Payment Procedures |
| Section 01 3100 | Project Management and Coordination |
| Section 01 3150 | Building Information Modeling (BIM) |
| Section 01 3300 | Submittals |
| Section 01 4000 | Quality Control Services |
| Section 01 4349 | Mock Up Requirements |
| Section 01 5000 | Temporary Facilities and Controls |
| Section 01 6000 | Product Requirements |
| Section 01 7300 | Execution Requirements |
| Section 01 7419 | Construction Waste Management and Disposal |
| Section 01 7700 | Closeout Procedures |
| Section 01 7800 | Operation and Maintenance Data |
| Section 01 7900 | Demonstration and Training |
| Section 01 9113 | General Commissioning Requirements |
| Section 01 9119 | Building Enclosure Functional Performance Testing Requirements |
| Section 01 9126 | Building Enclosure Commissioning Requirements |

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## SECTION 01 1000

## SUMMARY OF WORK

### PART 1 - GENERAL

### 1.1 SUMMARY

A. Requirements of **DIVISION 0 - BIDDING REQUIREMENTS** and **DIVISION 1 - GENERAL REQUIREMENTS** apply to **every section** contained in the Project Manual, and shall govern the execution of Work required by the Contract Documents.

B. Provide everything necessary for and incidental to proper and satisfactory completion of all Work specified and indicated or shown in the Contract Documents.

C. The Project consists of the **addition of the Student Activity Center** and **renovations** to the existing **Stromberg Athletic Complex** at **Weber State University.**

1. The project includes two stories and a mezzanine of new construction to the west side of the building, plus a pedestrian bridge across the Arena linking level two to the Swenson Complex and a suspended running track inside the existing Stromberg Arena. Office spaces within the Arena are to be remodeled as part of the project. The addition will house Student Recreation offices, lobby space, two fitness studios, shower/locker rooms, and an open fitness space. Spaces remodeled inside the existing building will include the suspended running track, pedestrian bridge, and office space. The area of the addition occurs in an existing parking lot. Modifications to this lot will occur as part of this project. Work to the existing building will include a reroof of the Arena, fireproofing the Arena roof structure, creating a building separation between the Stromberg Arena and the Swenson Complex, structural work to accommodate the suspended track and bridge, office remodel and finishes updating.

### 1.2 PROJECT LOCATION

A. The **Stromberg Athletic Complex** is located on the campus of **Weber State University**, 3848 Harrison Blvd., **Ogden, Utah**.

### 1.3 SEPARATE CONTRACTS

A. **The Owner may enter into separate contracts for construction**. Each contractor shall be responsible to coordinate efforts with other trade contractors to ensure timely completion of the work.

B. **Coordinate the Work** of this contract with the work of separate contractors to ensure timely completion of the work.

## 1.4 CODES

A. **Law of place of building governs**. Conform to applicable requirements of the latest editions of the **International Building Code**, International **Building Code Standards**, International **Mechanical Code**, International **Plumbing Code**, National **Electrical Code**, **National Fire Protection Association** requirements, local ordinances, **DFCM Building Standards (June 30, 2008)**, r**equirements of Weber State University** (WSU), and **OSHA** requirements applicable to this project, unless a higher standard is called for, without additional cost to the Owner.

B. **Comply** with **CABO/ANSI A117.1**, American National Standard, "**Accessible and Usable Buildings and Facilities**" latest edition which is in force for the project location, for handicapped accessibility.

## 1.5 CONTRACTOR USE OF PREMISES

A. **General:** During the construction period the Contractor shall have use of the premises for construction operations, including:
   1. The Contractor's use of the premises is limited only by the **Owner's right** to perform work or to **retain other contractors** on portions of the Project.

B. **Use of the Site**: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. **Driveways and Entrances**: Keep driveways and entrances serving the premises clear and available to the Owner and Owner's employees and students, as well as emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
   2. **Do not unreasonably encumber the site** with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated. If additional storage is necessary obtain and pay for such storage off-site.
   3. **Lock automotive type vehicles** such as passenger cars and trucks and other types of mechanized and motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

C. **Work Restrictions**
   1. Abide by all University regulations regarding traffic, parking, smoking, etc. Verify requirements with University personnel prior to mobilizing on site.
   2. Class schedules shall be observed (and in many situations, may dictate availability and access to the Work), to avoid undue disruption.

## 1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of the period from April 22, 2013 to August 1, 2013. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. **Maintain access to existing exits, stairs, walkways, corridors, and other adjacent occupied or used facilities**. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

## 1.7 PROJECT TIME FRAME

A. **Work associated with the existing Stromberg Arena may commence no sooner than April 22, 2013 and must be Substantially Complete no later than August 1, 2013**. Work to the existing building includes, but is not limited to, reroofing of the Arena, fireproofing the Arena roof structure, creating a building separation between the Stromberg Arena and the Swenson Complex, structural work to accommodate the suspended track and bridge, office remodel and updating of finishes.

B. Work associated with the addition to the Stromberg Arena may commence upon the award of the Contract for Construction and is strongly desired to be completed by August 1, 2013. Date of Substantial Completion for the addition shall be established by the Contract for Construction. Continuing work (if agreed) on the addition shall not interfere, delay or otherwise impinge upon the mandatory substantial completion date of August 1, 2013 for the Stromberg Arena itself.

## 1.8 DUST CONTROL

A. **The Contractor** shall be responsible to provide continuous (7 days per week, 24 hours per day) fugitive dust control measures within the limits of the construction site, related sites and adjacent streets and roads. Dust control shall be provided for, but not be specifically limited to, the stabilization of unpaved roads, haul roads, access roads, spoil sites, borrow and material sources, excavations, embankments, stockpiles, and all other areas which become potential sources of dust as a result of construction activities.

B. **Contractor's dust control measures** shall maintain compliance with the **General Utah Air Pollution Regulations**, R446 - Utah Air Conservation Regulations, Section 4.5, Fugitive Emissions, applicable County Air Pollution Control Ordinances, and as directed by the Architect. Dust control measures shall include but not be limited to the following:

1. **Wetting of surfaces** with water as appropriate.
2. **Minimizing surface disturbances**.

C. **In order to control fugitive dust emissions**, Contractor shall apply the following procedures and techniques:

1. **Cover loads of materials**, debris and waste materials taken from construction sites as needed to suppress dust during transit.

2. **Water down** or apply other approved dust control measures to the construction site, haul roads and public access roads as needed to suppress dust.
3. **All mud and dirt shall be removed** from vehicles prior to entering a paved or graveled area or road. Any mud or dirt that is carried out onto paved or graveled surfaces shall be removed from surfaces immediately and no less than daily.

D. **Biobased content**:
1. **Dust Suppressants**: Products formulated to reduce or eliminate the spread of dust associated with gravel roads, dirt parking lots, or similar sources of dust, including products used in equivalent indoor applications. Provide minimum 85% biobased content.

## 1.9 INCIDENTAL WORK

A. **Any work**, materials or equipment that **may reasonably be inferred** from the **Contract Documents** as being required to produce the intended result shall be supplied by the Contractor at no additional cost to the owner whether or not specifically called for in the Contract Documents.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

**END OF SECTION**

## SECTION 01 1900

## DEFINITIONS AND STANDARDS

### PART 1 - GENERAL

### 1.1 SUMMARY

A. **Definitions**: Basic Contract definitions are included in the General Conditions.

1. **Directed**: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Architect", "requested by the Architect", and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
2. **Approve**: The term "approved," where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
3. **Furnish**: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
4. **Install:** 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."
5. **Provide**: The term "provide" means "to furnish and install, complete and ready for the intended use."
6. **Protect**: Except as otherwise defined in greater detail, the term "protect" is used to describe the process of shielding from harm existing fixtures, elements or materials.

B. **Specification Format and Conventions:**

1. **Specification Format:** The Specifications are organized into Divisions and Sections using the 49 division format and CSI/CSC's "MasterFormat" numbering system.
   a. **Section Identification**: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
2. **Specification Content:** The Specifications use certain conventions for style of language and the intended meaning of terms, words, and phrases when used in particular situations. These conventions are as follows.
   a. **Abbreviated Language**: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

b. **Imperative mood** and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

1) The words “shall”, “shall be”, or “shall comply with”, depending on the context, are implied where a colon (:) is used within a sentence or phrase.

C. **Drawing Symbols**:

1. **Graphic symbols**: Where not otherwise noted, symbols are defined by "**Architectural Graphic Standards**", published by John Wiley & Sons, Inc., **latest edition**.

a. **Mechanical/Electrical Drawings**: Graphic symbols used on mechanical and electrical Drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by more specific symbols recommended by technical associations including ASME, ASPE, IEEE, and similar organizations. Refer instances of uncertainty to the Architect for clarification before proceeding.

D. **Industry Standards**:

1. **Applicability of Standards**: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards the Contractor must keep available at the Project Site for reference.
2. **Publication Dates**: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
3. **Conflicting Requirements**: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.
4. **Copies of Standards**: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

a. **Where copies of standards are needed** for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

b. **Although copies of standards needed** for enforcement of requirements also may be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

E. **Abbreviations and Names**: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

**END OF SECTION**

# SECTION 01 2300

# ALTERNATES

## PART 1- GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

### 1.3 DEFINITIONS

A. **Alternate**: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

B. **The cost** or **credit** for each alternate is the **net addition to** or **deduction from** the **Contract Sum** to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

### 1.4 PROCEDURES

A. **Coordination**: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

B. **Include as part of each alternate**, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. **Notification**: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

D. **Execution of Work**: Execute accepted alternates under the same conditions as other work of the Contract.

E. **Schedule**: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 SCHEDULE OF ALTERNATES

#### ADDITIVE ALTERNATE NO. 1

Provide cost to remove a portion of the athletic track surface in the existing Stromberg Arena and replace with new athletic flooring. Replace all flooring that is currently green in color. Refer to the Demolition Floor Plan (AD101) and Finish Plans (A111.3 and A112.3) for defined area. Provide new athletic fitness flooring per Division 9 Section "Resilient Athletic Flooring".

#### DEDUCTIVE ALTERNATE NO. 2

Provide cost to used spray-applied fireproofing in the Stromberg Arena at the deck and roof structure, in lieu of base bid intumescent paint, to meet the required Type IB fire protection requirements. Alternate shall include all preparatory work for spray-applied fireproofing on steel to provide a fully functional, warrantable fireproofing system. Structural members in the addition noted to be protected by intumescent paint are to remain as detailed.

**END OF SECTION**

## SECTION 01 2600

## CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section specifies administrative and procedural requirements for handling and processing Contract modifications**.
   1. The processes outlined herein represent the Architect's standard method for addressing contract modifications. Procedures of the State of Utah Division of Facilities Construction and Management (DFCM) and Weber State University, as published on the DFCM website and in the Weber State "Design and Construction Standards for Architects, Engineers and Contractors" shall take precedence over any process outlined herein where a conflict, if any, exists.

B. **Related Sections include the following**:
   1. **Division 1** Section "**Product Requirements**" for administrative procedures for handling requests for substitutions made after Contract award.

### 1.3 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 forms issued by the **Architect** or the **Owner**.

### 1.4 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. **Within time specified** in Proposal Request 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 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 the 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.

C. **Proposal Request Form**: Use forms issued by the **Architect** or the **Owner**.

## 1.5 CHANGE ORDER PROCEDURES

A. **On Owner's approval of a Proposal Request**, Architect will issue a **Change Order** for signatures of **Owner** and **Contractor** on forms issued by the **Architect** or the **Owner**.

## 1.6 CONSTRUCTION CHANGE DIRECTIVE

A. **Construction Change Directive**: Architect may issue a Construction Change Directive on **AIA Document G714**. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. **Construction 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 Construction 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**

## SECTION 01 2900

## PAYMENT PROCEDURES

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section specifies** administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. **Related Sections** include the following:
   1. **Division 1** Section "**Contract Modification Procedures**" for administrative procedures for handling changes to the Contract.

### 1.3 DEFINITIONS

A. **Schedule of Values**: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

### 1.4 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 the following:
      a. **Application for Payment forms** with Continuation Sheets.
      b. **Submittals** Schedule.
      c. **Items required** to be indicated **as separate activities** in Contractor's construction schedule.
   2. **Submit the Schedule of Values to Architect** 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 the Schedule of Values** in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value.
      1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
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. Provide several line items for principal subcontract amounts, where appropriate.
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.
   a. **Differentiate** between items **stored on-site** and items **stored off-site**. Include evidence of insurance or bonded warehousing if required.
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.
   a. **Temporary facilities** and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. **Schedule Updating**: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

## 1.5 APPLICATIONS FOR PAYMENT

A. **General**: Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   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**: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. **Payment Application Forms**: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form 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. Architect will return incomplete applications without action.
   1. **Entries shall match data on the Schedule of Values** and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. **Include amounts of Change Orders** and Construction Change Directives 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 liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. **Submit partial waivers** on each item for amount requested, before deduction for retainage, on each item.
   2. **When an application shows** completion of an item, submit final or full waivers.
   3. **Owner reserves the right** to designate which entities involved in the Work must submit waivers.
   4. **Waiver Delays**: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.
      a. **Submit final Application for Payment** with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. **Waiver Forms**: Submit waivers of lien on forms, executed in a manner 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. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Performance and payment bonds.
   15. Data needed to acquire Owner's insurance.
   16. Initial settlement survey and damage report if required.

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**: 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 statemen**t, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "**Contractor's Affidavit of Payment of Debts and Claims**."
   5. AIA Document G706A, "**Contractor's Affidavit of Release of Liens**."
   6. AIA Document G707, "**Consent of Surety to Final Payment**."
   7. **Evidence** that claims have been settled.
   8. **Final meter readings for utilities**, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
   9. **Final, liquidated damages** settlement statement.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

# SECTION 01 3100

# PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Administrative and supervisory personnel.
5. Project meetings.

B. **Each contractor shall participate in coordination requirements**. Certain areas of responsibility will be assigned to a specific contractor.

C. **Related Sections**: The following Sections contain requirements that relate to this Section:
1. **Division 1** Section "**Execution Requirements**" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. **Division 1** Section "**Submittals**" for procedures for coordinating electronic submittals.
3. **Division 1** Section "**Closeout Procedures**" for coordinating Contract closeout.

### 1.3 COORDINATION

A. **Coordination**: Coordinate construction operations included in various 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. **Make adequate provisions** to accommodate items scheduled for later installation.

B. **Memoranda**: If necessary, 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 Owner 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 and activities of other contractors 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 Contractor's 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.

D. **Administrative Software requirements**: The General Contractor shall submit all project related information (i.e. Submittals, RFI's, ASI's, Addenda, Construction documents, Project logs, Field reports, and Meeting minutes) using the **Architect's File Transfer Site.** Architect will provide access information to the General Contractor at the pre-construction meeting or as appropriate to the schedule of the project.
1. The General Contractor shall employ a PDF review software system such as Blue Beam (www.bluebeam.com) or another similar system for producing, formatting, and marking-up project related documents. The General Contractor shall review all the documents and add their stamp and comments directly to the PDF prior to posting for the Design team to review.
2. General Contractor shall provide to the Architect and Owner, an electronic archive of all data at the end of the project via DVD(s) for final project records.

E. Contractor is to keep a **printed record** of all Construction Documents including all clarifications, RFI's and approved changes to the Contract **on site**.

F. **Conservation**: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

## 1.4 SUBMITTALS

A. **Coordination Drawings**: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. **Indicate relationship of components** shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. **Refer to Division 23** Section **"Basic Mechanical Materials and Methods"** and **Division 26** Section **"Basic Electrical Materials and Methods"** for specific Coordination Drawing requirements for mechanical and electrical installations.

B. **Staff Names**: Within **5 business days** of starting construction operations, submit a list of **principal staff assignments**, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of **individuals assigned as standbys** in the absence of individuals assigned to Project.
1. **Post copies** of list in Project meeting room, in temporary field office, and by each temporary telephone.

C. **Submittal Log**: See section 'Submittals' for electronic delivery and record keeping.

## 1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. **General**: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
   1. Include special personnel required for coordination of operations with other contractors.
   2. The General Contractor shall have a superintendent on the project whenever Sub-contractors are working on the project.

## 1.6 PROJECT MEETINGS

A. **General**: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. **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 dates and times.
   2. **Agenda:** Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. **Minutes:** Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

B. **Preconstruction Conference**: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than [15] days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. **Attendees**: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. **Agenda**: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing.
      d. Designation of responsible personnel.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for processing Applications for Payment.
      g. Distribution of the Contract Documents.
      h. Submittal procedures including access information to the Architect's File Transfer Site.
      i. Preparation of Record Documents.
      j. Use of the premises.
      k. Responsibility for temporary facilities and controls.
      l. Parking availability.
      m. Office, work, and storage areas.
      n. Equipment deliveries and priorities.
      o. First aid.
      p. Security.
      q. Progress cleaning.
      r. Working hours.

3. Documentation: Furnish Architect certificate of insurance naming VCBO as an additional insured.

C. **Progress Meetings**: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. **Attendees**: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. **Agenda**: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. **Contractor's Construction Schedule**: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. **Review present and future needs** of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Work hours.
      10) Hazards and risks.
      11) Progress cleaning.
      12) Quality and work standards.
      13) Change Orders.
      14) Documentation of information for payment requests.
3. **Reporting**: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
   a. **Schedule Updating**: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

## 1.7 REQUESTS FOR INFORMATION (RFI)

A. **Procedure:** Immediately on discovery of the need for interpretation of Contract Document, and if not possible to request interpretation at Project meeting, prepare and submit an **RFI** in the form specified.

1. Request shall originate with **General Contractor**. RFI's submitted by entities **other than General Contractor** will be **returned with no response**.
2. **Coordinate** and submit RFI's in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. **Content of the RFI**: Include a detailed, legible description of item needing interpretation and the following:
   1. Project **name**.
   2. **Date**.
   3. Name of **Contractor**.
   4. Name of **Architect** and **Owner**.
   5. **RFI number**, numbered sequentially.
   6. **Specification Section** number and title and related paragraphs, as appropriate.
   7. **Drawing number** and detail references, as appropriate.
   8. **Field dimensions** and conditions, as appropriate.
   9. **Contractor's suggested solution(s)**. If Contractor's solution(s) impact the Contractor Time or the Contract Sum, Contractor shall state impact in the RFI.
   10. **Contractor's** signature.
   11. **Attachments**: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      a. **Supplementary drawings** prepared by Contractor shall include dimensions, thickness, structural grid references, and details of affected materials, assemblies, and attachments.

C. **Hard-Copy RFI's**: Use the **form supplied** by the **Architect** or the **Owner**.
   1. **Identify** each page of attachments with the RFI number and sequential page number.
   2. **Attachments** shall be electronic files in **Adobe Acrobat PDF** format.

D. **Electronic RFI's**:
   1. RFI's shall be **processed and delivered electronically** through Architect's File Transfer Site with sequential numbers.

E. **Architect's Action**: Architect will review each RFI, determine action required, and return it. Allow **seven working days** for Architect's response for each RFI. RFI's received after **1:00 p.m**. will be considered as received the following working day.
   1. **The following RFI's** will be returned **without action**:
      a. Requests for **approval of submittals**.
      b. Request for **approval of substitutions**.
      c. Requests for **coordination information** already indicated in the Contract Documents.
      d. Request for **adjustments in the Contract Time** or **Contract Sum**.
      e. Requests for **interpretation of Architect's actions** on submittals.
      f. **Incomplete RFI's** or RFI with numerous errors.
   2. **Architect's action** may include a **request for additional information**, in which case Architect's Time for response will start again.
   3. **Architect's action** on RFI that may result a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
      a. **If Contractor believes** the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner in writing within **10 calendar days** of receipt of the RFI response.

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

G. **RFI Log**: Prepare, maintain, and submit a tabular log of RFI's organized by RFI number. Submit log monthly.
   1. **Project** name.
   2. Name and address of **Contractor**.
   3. Name and address of **Architect** and **Owner**.
   4. **RFI number** including RFI's that were dropped and not submitted.
   5. **RFI description**.
   6. **Date** the RFI was submitted.
   7. **Date** Architect's and Owner's **response** was received.
   8. **Identification of related Minor Change** in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   9. **Identification of related Field Order**, Work Change Directive, and Proposal Request, as appropriate.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01 3150

## BUILDING INFORMATION MODELING (BIM) COORDINATION AND SUBMITTALS

### PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. **Coordination of Architectural building component**s and Structural systems with the Plumbing, Fire Protection Sprinkler System, HVAC Sheetmetal and Piping and Electrical Work, under the supervision of the General Contractor.
   1. Regularly scheduled meetings with mandatory participation.
   2. Full size plots and copies are required for drawing submittals and drawing distribution.
   3. Creation and ongoing maintenance of the 3-dimensional electronic building model, including coordination of all building components, including updates during construction process.

B. **Each individual Contractor shall maintain** each set of drawings and the specifications current with all bulletins and other changes to the Contract Documents as follows:
   1. Drawings: Insert new drawings in front of each voided drawing in a set. Note each voided drawing as such. Voided drawings are to remain in each set. Attach revisions to drawings issued on 8-1/2 x 11 inch paper to each drawing. Indicate on the drawings where a change references the 8-1/2 x 11 inch sheet.
   2. Specifications: Insert revisions as may be required.

C. **Each individual subcontractor shall maintain Building Information Modeling (BIM) contract documents** and shop drawings for their division of work, as indicated in this specification section.
   1. BIM model shall include any of the following components that may impact coordination with other disciplines in the interstitial spaces of the building:
      All ducts, pipes, conduits, racks, trays, etc.
      All equipment.
      Insulation
      Hangers and seismic restraints.
      Required clearance and access zones.
      a. List is not all inclusive - items excluded from the model are the responsibility of the subcontractor to coordinate in the field without additional compensation.
      b. All components shall be drawn to scale.
      c. Subcontractor is responsible to ensure constructability of all components of their trade.
      d. Subcontractor shall verify that all components conform to specification requirements.
   2. Each subcontractor's model shall be free of structural and architectural conflicts prior to being submitted for MEP coordination.
   3. Subcontractors shall furnish lists of any required clearances for model components to the General Contractor and to each other.
   4. Subcontractors providing deferred submittals for mechanical, electrical or fire protection systems shall provide copies of the BIM model, demonstrating coordination of their components with other elements in the building, along with their shop drawings.

5. Subcontractors shall provide BIM modeling either through their own in-house drafting capabilities or through an outside source. All costs related to development and maintenance of the BIM modeling required by the work of an individual contractor shall be the responsibility of that contractor.

D. The General Contractor shall maintain, up-to-date, the comprehensive set of construction documents, reflecting coordination of all building elements, both in hard copy form and in the Building Information Model (BIM) form.
   1. The General Contractor shall thoroughly investigate and model the placement of all building components including but not limited to, mechanical, electrical, structural, fire protection, and architectural elements and shall be responsible for the necessary final coordination of all items to avoid conflicts and "clashes" through use of the BIM contract documents.
   2. AutoDesk "Navisworks Manage" or comparable software shall be used to generate the coordinated BIM model. Software must be compatible with AutoDesk Revit and other drafting and modeling software used for the project documents.
   3. All costs associated with development and maintenance of the Building Information Model (BIM), coordination of components electronically and in the field, and costs associated with corrections necessary to properly install and connect components due to failure to fully investigate their relationship to one another and to the building as a whole shall be the responsibility of the Contractor.

E. The built project shall conform to these coordination drawings.

## 1.2 COORDINATION MEETINGS

A. **Pre-Construction Coordination Meetings:**
   1. Attendees: The following MUST attend all pre-construction coordination meetings: Engineer, Architect, General Contractor, subcontractors, representatives of Division of Facilities and Construction Management and Weber State University, and the Commissioning Authority.
   2. Meetings shall be held to coordinate zoning of systems in interstitial spaces within the building.
   3. Participants shall be fined $1,000 dollar penalty per firm per meeting missed for mandatory coordination meetings.

B. **Coordination Meetings**: Conduct construction coordination meetings at weekly intervals.
   1. Attendees: Each Contractor, Subcontractor, Supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Failure to attend will be assumed to indicate agreement to take full responsibility for any conflict resulting from the non-attending party's work on the project.
   2. Any Subcontractor or vendor who is unwilling to provide information for the building coordination in a timely manner shall pay for any needed changes to accommodate the installation of their equipment.

3. Agenda: Review and correct coordination documents. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction and procurement that is behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Procurement schedule.
      5) Quality and work standards.
      6) Change Orders, schedule updates to coordination models.
4. Reporting: Distribute minutes of the meeting to the Owner, Architect, each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

## 1.3 COORDINATION DRAWINGS

A. **General Drawing Format:**
   1. Coordination drawings shall be submitted at 1/4" = 1'-0".
   2. The limits of each coordination drawing shall be indicated on the Coordination Drawing with a match line indicating adjacent area and referenced sheet.
   3. Drawings shall be prepared using the Building Information Model (BIM) so that any Coordination Drawing within the same area can be viewed together and conflicts highlighted.
   4. Each Contractor shall provide coordination drawings as specifically indicated.
   5. Each Contractor shall be responsible for all drawing reproduction costs as specified hereinafter.
   6. Building Information Model (BIM) software shall be compatible with, and capable of being exported to, Autodesk Revit format, without loss of data or changes in formatting.

B. **Background Drawings**: For each Coordination Drawing, unless otherwise noted:
   1. Title Block: This sheet will have the drawing borderline and Title Blocks for use by each Prime Contractor, and their subContractors, as may be required. Provide space for indication of the drawing scale, drawing number, and draftsmen' name. Provide a block for Sign-Off by the following:
      a. HVAC Contractor
      b. Plumbing Contractor
      c. Fire Protection Contractor
      d. Electrical Contractor
      e. Mechanical/Electrical Engineer
      f. General Contractor

2. **General**: BIM models will be provided by the design team for the Contractors' use in developing coordination documents. Such models shall be in Autodesk Revit software. The Contractors are responsible to verify the information on the printed bid documents are reflected correctly in all the BIM models. **See Section 00 03100, "Available Information With Agreement Concerning Drawing Files On Electronic Media"**. The Contractor, Subcontractors and Suppliers shall verify that the BIM models furnished are correct and complete.
3. **Design Revit Model**: Verify all structural members are located and properly sized. Indicate the bottom elevation of each horizontal element, decking, and acoustical isolating ceilings. Typical elevations may be noted so. Indicate dimensions between vertical elements. Wall types, reflected ceiling plans and wall elevations shall be indicated, including fire and smoke separations walls (to verify the locations of smoke and fire dampers). Architectural interior elevations shall include locations of mechanical, plumbing and electrical items.

C. **HVAC Sheet Metal Drawings**: For each coordination drawing and BIM model:
1. Lay out ductwork and other equipment to clear all beams, columns, and other construction. Maintain all required vertical and horizontal clearances, as specified.
2. Draw each horizontal duct run to scale; indicate width, depth, and elevation of bottom of ducts including insulation and hangers. Single line diagrams are not acceptable. Note bottom elevation of duct flanges, angle iron and unistrut hangers, as may be applicable. In BIM model, show all elements in true scale and location.
3. Dimension the location of each horizontal duct from column centerlines.
4. Indicate and dimension the location of boxes, fire dampers, smoke dampers, registers, grilles, diffusers, and other equipment. Note all items requiring access for maintenance. Indicate location and type of all access panels required.
5. Show vertical duct risers in their total length. Dimension the location of each vertical duct riser from column centerlines in two directions.
6. Indicate routing for all conduits associated with the temperature control system, as specified under Electrical Coordination Drawings.
7. Note all deviations from contract documents in routing and placement of fittings for review by the Mechanical Engineers.
8. Draft details, sections, and elevations, where required, or directed, for clarity.
9. Draft installation details of mechanical grilles and architectural grilles.

D. **HVAC Piping Drawings**: For each coordination drawing and BIM model:
1. Lay out piping, valves, and other equipment to clear all beams, columns, and other construction, and to avoid conflicts with ductwork and equipment indicated on the HVAC Coordination Drawings. Maintain all required vertical and horizontal clearances, as specified. In BIM model, show all elements in true scale and location.
2. Show sizes and locations of all piping and related equipment. Dimension locations from column centerlines and indicate bottom elevations of pipes, including insulation and hangers, where applicable. Note flange and coupling sizes where applicable. Note all items requiring access for maintenance. Indicate location and type of all access panels required.
3. Indicate all piping types, piping materials, amounts and types of insulation.
4. Where piping slopes, indicate direction of pitch. At long runs, note bottom elevations at each end.
5. Note all deviations from contract documents in routing and placement of fittings for review by the Mechanical Engineers.
6. Indicate where spring isolator hangers are to be used.
7. Draft details, sections, and elevations, where required, or directed, for clarity.

E. **Plumbing Coordination Drawings**: For each coordination drawing and BIM model:

1. Lay out piping, valves, and other equipment to clear all beams, columns, and other construction, and to avoid conflicts with HVAC ductwork, piping, and equipment indicated on the HVAC Coordination Drawings. Maintain all required vertical and horizontal clearances, as specified. In BIM model, show all elements in true scale and location.
2. Show sizes and locations of all piping and related equipment. Dimension locations from column centerlines and indicate bottom elevations of pipes, including insulation and hangers, where applicable. Note all items requiring access for maintenance. Indicate location and type of all access panels required.
3. Indicate all piping types, piping materials, amounts and types of insulation.
4. Where piping slopes, indicate direction of pitch. At long runs, note bottom elevations at each end.
5. Note all deviations from contract documents in routing and placement of fittings for review by the Mechanical and Acoustical Engineers.
6. Indicate where spring isolator hangers are to be used.
7. Draft details, sections, and elevations, where required, or directed, for clarity.
8. Indicate where support backing is required in walls and ceilings.

F. **Fire Protection Coordination Drawings**: For each coordination drawing and BIM model:

1. Lay out piping, valves, and other equipment to clear all beams, columns, and other construction. Avoid conflicts with HVAC ductwork, piping, and equipment indicated on the HVAC Coordination Drawings. Avoid conflicts with plumbing piping and equipment indicated on the Plumbing Coordination Drawings. Maintain all required vertical and horizontal clearances, as specified. Avoid location piping over electrical and data equipment and panels. In BIM model, show all elements in true scale and location.
2. Show sizes and locations of all piping and related equipment. Dimension locations from column centerlines and indicate bottom elevations of pipes including hangers. Note all items requiring access for maintenance. Indicate location and type of all access panels required.
3. Indicate all piping types and piping materials.
4. Where piping slopes, indicate direction of pitch. At long runs, note bottom elevations at each end.
5. Note all deviations from contract documents in routing and placement of fittings for review by the Fire Protection Engineer.
6. Indicate where spring isolator hangers are to be used.
7. In general, locate sprinkler heads as indicated on the contract drawings. Dimension locations of sprinkler heads from room walls. Coordinate with reflected ceiling plan prepared by the HVAC Contractor.
8. Indicate locations for drain valves for trapped sections of piping.
9. Draft details, sections, and elevations, where required, or directed, for clarity.

G. **Electrical Coordination Drawings**: For each coordination drawing and BIM model:

1. Lay out conduit, wireway, and other equipment to clear all beams, columns, and other construction. Avoid conflicts with HVAC ductwork, piping, and equipment indicated on the HVAC Coordination Drawings. Avoid conflicts with Plumbing piping and equipment indicated on the Plumbing Coordination Drawings. Avoid conflicts with Fire Protection piping and equipment indicated on the Fire Protection Coordination Drawings. Maintain all required vertical and horizontal clearances, as specified. In BIM model, show all elements in true scale and location.
2. Show routings of all individual power and lighting conduits larger than 2 inches, and racks of conduits 1/2 inch and larger.

3. Show routings of all conduits for auxiliary electric systems.
4. Show sizes and locations of all cable trays and related equipment. Dimension locations from column centerlines and indicate bottom elevations of cable trays including hangers. Contractor shall provide unobstructed access to all cable tray.
5. Where conduit routes have been indicated on the drawings, note all deviations from contract documents in routing for review by the Electrical Engineer.
6. Indicate and show sizes of all Electrical Equipment. Dimension locations from column centerlines or walls, as may be appropriate. Note all items requiring access for maintenance. Indicate location and type of all access panels required.
7. Draft details, sections, and elevations, where required, or directed, for clarity.

## 1.4 COORDINATION DRAWING PROCEDURE

A. **HVAC Sheet Metal Contractor**:
1. For each drawing indicated, the HVAC Sheetmetal Contractor shall complete the layout of ductwork and equipment as specified above. The HVAC Sheetmetal Contractor shall then deliver to HVAC piping Contractor the digital models.

B. **HVAC Piping Contractor**:
1. For each drawing indicated, the HVAC piping Contractor shall complete the layout of piping and equipment as specified above. The HVAC Piping Contractor shall then deliver to Plumbing Contractor the digital models.

C. **Plumbing Contractor**:
1. For each drawing indicated, the Plumbing Contractor will complete the layout of piping and equipment as specified above. The Plumbing Contractor will then deliver to Fire Protection Contractor the digital models.

D. **Fire Protection Contractor:**
1. For each drawing indicated, the Fire Protection Contractor will complete the layout of piping and equipment as specified above. The Fire Protection Contractor will then deliver to the Electrical Contractor the digital models.

E. **Electrical Contractor:**
1. For each drawing indicated, the Electrical Contractor will complete the layout of conduit and equipment as specified above.

F. General Contractor:
1. Shall overlay the BIM models and review for conflict. All conflicts shall be flagged and resolved in the coordination meetings.

## 1.5 COORDINATION DRAWING AND MODEL SUBMITTAL

A. For each coordination drawing and BIM model, each Contractor shall submit their layout to the Architect for **information only**. These shop drawings shall be a composite drawing consisting of the Contractors' layout superimposed on the architectural and structural background model. The architectural and structural background model components shall be screened 30% for clarity. Submit after the initial layout is complete. Upon request, submit pdf copies.

## 1.6 COORDINATION MEETINGS

A. For each coordination drawing, after all the Contractors have completed the layout for their division of work, the General Contractor shall schedule a coordination meeting to review and resolve coordination drawing conflicts.

## 1.7 COORDINATION DRAWING SIGN-OFF

A. When all of the Contractors are satisfied that coordination drawing conflicts have been resolved, each Contractor will sign off on the coordination drawings. The Contractor's signature will signify that the Contractor has reviewed each trades' coordination drawings and will also signify the Contractor's intention to complete installation as indicated on coordination drawings. Installation conflicts will be resolved as dictated by these.

## 1.8 MAINTAIN COORDINATION DRAWING

A. The Contractor and Subcontractors shall maintain the digital BIM coordination documents to reflect the as-built conditions, including all changes issued to the project. The General Contractor shall provide the fully coordinated and up-to-date BIM coordination documents to the Owner and Architect for their records at the completion of the project, as part of the close-out documents.

B. Review of the coordination drawings by the Architect shall be only for the purpose of determining conformance to design intent. All means and methods of construction, coordination and management of subcontractors, scheduling and other processes of construction remain the sole responsibility of the General Contractor and the subcontractors.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

**END OF SECTION**

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# SECTION 01 3300

# SUBMITTALS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. **This Section specifies** administrative and procedural requirements for submittals required for performance of the Work, including:
   1. Contractor's construction schedule.
   2. Daily construction reports.
   3. Shop Drawings.
   4. Product Data.
   5. Samples.
   6. Deferred Submittals for review by the Building Code Official.

B. **Administrative Submittals**: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
   1. Applications for payment.
   2. Performance and payment bonds.
   3. Insurance certificates.
   4. List of Subcontractors.

C. **Inspection and test reports** are included in Section "Quality Control Services."

D. **Related Documents**: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.
   1. **Division 1** - Project Management: Electronic web-based construction administration software.

### 1.2 ELECTRONIC SUBMITTAL DELIVERY

A. **To minimize printing reimbursables**, shipping reimbursables and the impact on the environment, submittals shall be processed and delivered electronically through the Architect's File Transfer Site (FTS).
   1. A single hard copy shall also be furnished.

B. **The Construction Manager, Contractor or Subcontractor shall originate submittals** via the Architect's File Transfer Site. The Construction Manager or Contractor must first review and approve all submittals sent by Subcontractors prior to sending to design team. Include Contractor's certification that information complies with Contract Document requirements, record deviations from Contract Document requirements, including minor variations and limitations. Submittals uploaded by subcontractors shall not be visible to the Design team until the submittal becomes official and is forwarded from the Construction Manager or Contractor to the Design team via the FTS with a transmittal.

C. **Submittals must follow the requirements** outlined in this specification and as required in individual specification sections.

D. **The following types of submittals** shall be delivered to the design team electronically in **pdf format:**
   1. Product Data
   2. Shop Drawings
   3. Certifications
   4. Test Data
   5. Schedules
   6. Calculations
   7. Mix Designs
   8. Warranty Information

E. **Samples And Color Selection**
   1. All samples/color selections shall be delivered by mail or courier to the design team for review.
   2. Samples and color selection shall not be reviewed electronically.
   3. See separate specification sections for quantities and sample selection process. The design team shall return review comments via the Architect's File Transfer Site.

F. **Submittal Stamps**
   1. The Contractor or Construction Manager shall affix an electronic stamp to PDF submittals.

G. **Submittal Logs**
   1. The design team shall maintain the submittal log through FTS.
   2. It is not required that the Contractor maintain a separate submittal log between the Subcontractors and Contractor.
   3. Construction team shall make a reasonable effort to deliver all submittals electronically via FTS. Submittals shall not be delivered by email.
   4. Samples shall be logged in via FTS, but delivered hardcopy by mail

## 1.3 SUBMITTAL PROCEDURES

A. **No submittal will be accepted** by the Architect without the **General Contractor's action stamp**, clearly visible, indicating that the submittal has been fully reviewed by the General Contractor for compliance to the Construction Documents.

B. Submittals with the General Contractors stamp but **not in compliance with the Construction Documents will be deemed incomplete** and returned without review. These will not be shown as received.

C. **Coordination**: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
   1. **Coordinate transmittal** of different types of submittals for **related elements** of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
      a. **The Architect reserves the right** to **withhold action** on a submittal requiring **coordination with other submittals** until related submittals are received.

D. **Processing Time**: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.

1. **Initial Review**: Allow **15 business days** for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. **Concurrent Review**: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow **20 business days** for initial review of each submittal.
3. **Deferred Submittal Review**: Where deferred submittals are required by the Building Code Official allow review time as dictated by the Official.
4. **If intermediate submittal** is necessary, process it in same manner as initial submittal.
5. **Allow 15 business days** for processing each resubmittal.
6. **No extension of the Contract Time** will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

E. **Submittal Preparation**: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. **Include the following information** on the label for processing and recording action taken.
   a. Project name.
   b. Date.
   c. Name and address of **Architect**.
   d. Name and address of **Contractor**.
   e. Name and address of **Subcontractor**.
   f. Name and address of **Supplier**.
   g. Name of **Manufacturer**.

F. **Submittal Transmittal**: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

1. **On the form**, or separate sheet, record **deviations** from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

G. **Submittal requirements for electronic PDF submittals**:

1. All submittals shall be created with native PDF files whenever possible. Do not print a PDF file, and scan in as an image file, as this will delete all file search functions typically embedded within a native PDF file.
2. All PDF submittals shall be broken down by individual specification section. Do not collate multiple specification sections together into one non-separated submittal package (i.e. carpet, VCT, rubber base, and entry mats; though frequently provided by one installer, shall not be submitted as one non-separated package unless formatted as described below.)
3. All PDF submittals that cover multiple items within one specification section, or PDF submittals that include multiple related specification sections shall have an index and be formatted with electronic book marks to distinguish various components from one another, and make each item easily retrievable without navigating through each page of an entire submittal.

## 1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. **Bar-Chart Schedule**: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule.
   1. **Provide a separate time bar** for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".
   2. **Within each time bar** indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
   3. **Prepare the schedule** on a sheet of sufficient width to show data for the entire construction period.
   4. **Secure time commitments** for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
   5. **Coordinate the Contractor's construction schedule** with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
   6. **Indicate completion** in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. **Distribution**: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
   1. **When revisions are made**, distribute 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 construction activities.

C. **Schedule Updating**: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

## 1.5 DAILY CONSTRUCTION REPORTS

A. **Daily Construction Report**: Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Architect at weekly intervals:
   1. List of subcontractors at the site.
   2. Approximate count of personnel at the site.
   3. High and low temperatures, general weather conditions.
   4. Accidents and unusual events.
   5. Meetings and significant decisions.
   6. Stoppages, delays, shortages, losses.
   7. Meter readings and similar recordings.
   8. Orders and requests of governing authorities.
   9. Change Orders received, implemented.
   10. Services connected, disconnected.

B. **Material Location Reports**: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. **Field Condition Reports**: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 1.6 SPECIAL REPORTS

A. **General**: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. **Reporting Unusual Events**: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## 1.7 SHOP DRAWINGS

A. **Submit in timely manner to complete project**, but no later than **90 days** after Notice of Award.
   1. A fee of $100.00 will be charged by the Owner, per submittal for all submittals past this date.

B. **Submit newly prepared information**, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings.

C. **Shop Drawings** include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
   1. Dimensions.
   2. Identification of products and materials included.
   3. Compliance with specified standards.
   4. Notation of coordination requirements.
   5. Notation of dimensions established by field measurement.

D. **Sheet Size**: Submit Shop Drawings, layout drawings and other **Revit or CADD** style sheets formatted for 24" x 36" or 30" x 42" sheets. Details and drawings are to match or exceed construction bid document scales. **All drawings are to be submitted to scale.** All other product brochures and cut sheets can be provided in an 8-1/2 x 11 format.

E. **Final Electronic Submittal**: Submit 2 prints, one for the Architect and one for the Owner at the end of the project or as requested by the parties during construction.
   1. If submittal was reviewed by members of the design team other than the Architect, provide an additional copy of the submittal for each design firm.
   2. The prints shall be marked-up and maintained as a "**Record Document**".

F. **Final Submittal**: Submit 5 prints. 2 prints will be retained; the remainder will be returned.
   1. One of the prints returned shall be marked-up and maintained as a "**Record Document**".
   2. **Do not use Shop Drawings** without an appropriate final stamp indicating action taken in connection with construction.

## 1.8 DELEGATED-DESIGN/DEFERRED SUBMITTALS

A. **Some building elements** are specified to be **designed** under the direction of the **supplier or subcontractors**. See the General Information sheet on the drawings for a list of required deferred submittals.

B. **Performance and Design Criteria:** Where professional design services or certifications by a Design Professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

C. **All deferred submittals** are to be submitted on **same size sheet** as original drawings (30 x 42 or 8 1/2 x 11). Drawings and calculations shall be on the responsible Design Professional's title block stating the project name and all other items specified under 'Submittal Preparation' above.

D. **Delegated-Design Services Certification:** In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and 3 paper copies of certificate, signed and sealed by the responsible Design Professional, for each product and system specifically assigned to Contractor to be designed or certified by a Design Professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

E. **Deferred submittals** shall be submitted to the **Architect who will disperse three copies** to the Building Code Official for review as required by the IBC.

F. **Contractor shall include** these submittal sheets in the Record Documents.

## 1.9 PRODUCT DATA

A. **Submit in timely manner to complete project**, but no later than **90 days** after Notice of Award.

B. **Collect Product Data into a single submittal** for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

1. **Mark each copy to show applicable choices and options.** Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
   a. Manufacturer's printed recommendations.
   b. Compliance with recognized trade association standards.
   c. Compliance with recognized testing agency standards.
   d. Application of testing agency labels and seals.
   e. Notation of dimensions verified by field measurement.

C. **Do not submit Product Data** until compliance with requirements of the Contract Documents has been confirmed.

D. **Submittals**: Submit one hard copy and one electronic copy of each required submittal; submit additional copies where required for maintenance manuals. The Architect will retain one, and will return the other marked with action taken and corrections or modifications required.

E. **Electronic Submittals**: Submit a pdf copy and a hard copy of each required submittal; include copies where required for maintenance manuals. See electronic submittal delivery and submittal procedures for further requirements

## 1.10 SAMPLES

A. **Submit in timely manne**r to complete project, but no later than **90 days** after Notice of Award.

B. **Samples**: Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

C. **Submittals**: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.

1. **Maintain sets of samples and a file of product submittals**, as returned, at the Project site, for quality comparisons and product verification throughout the course of construction.

## 1.11 CONTRACTOR'S REVIEW

A. **Contractor's Review**: Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. **Approval Stamp**: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

C. **Submittals not marked** with an approval stamp and those not in compliance with the Construction Documents shall be returned without further review. It is the Contractor's responsibility to review submittals for compliance prior to forwarding the submittal to the Design Team for review.

## 1.12 ARCHITECT'S ACTION

A. **Architect's Action**: Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is the Contractor's responsibility.

B. **Action Stamp**: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked to indicate the action taken.
   1. **Corrections or comments made on the shop drawings** during this review **do not relieve the Contractor from compliance with requirements of the drawings and specifications**. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for; confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION - NOT USED

**END OF SECTION**

# SECTION 01 4000

# QUALITY CONTROL SERVICES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. **This Section specifies administrative** and **procedural** requirements for quality control services.

B. **Quality control services include inspections** and **tests** and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. **Inspection and testing services are required** to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
   1. **Specific quality control requirements** for individual construction activities are specified in the Sections that specify those activities.
   2. **Inspections, test and related actions** specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

D. **Requirements for the Contractor** to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

E. **Related Documents**: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

### 1.2 RESPONSIBILITIES

A. **Contractor Responsibilities**:
   1. **Unless otherwise indicated** as the responsibility of another identified entity, **Contractor shall provide inspections**, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. **Costs** for these services shall be **included in the Contract Sum**.
      a. **Where individual Sections** specifically indicate that certain inspections, tests, and other quality-control services are the **Contractor's responsibility**, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
      b. **Where individual Sections specifically indicate that certain inspections**, tests, and other quality-control services are the **Owner's responsibility**, the Owner will employ and pay a qualified independent testing agency to perform those services.
   2. **Retesting**: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

3. **Cost of Retesting**: Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
4. **Associated Services**: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
   a. **Providing access to the Work** and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
   b. **Taking adequate quantities** of representative samples of materials that require testing or assisting the agency in taking samples.
   c. **Providing facilities for storage** and curing of test samples, and delivery of samples to testing laboratories.
   d. **Security and protection** of samples and test equipment at the Project site.

B. **Owner Responsibilities**: The Owner will provide inspections, tests and similar quality control services **specified to be performed by independent agencies** and **not by the Contractor**, **except** where they are **specifically indicated as the Contractor's responsibility** or are provided by another **identified entity**. **Costs** for these services are **not included** in the Contract Sum.
   1. **The Owner will employ and pay** for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

C. **Duties of the Testing Agency**: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction **specified in individual Specification Sections** shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
   1. **The agency shall notify the Architect and Contractor** promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. **The agency** is **not authorized** to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
   3. The agency shall not perform any duties of the Contractor.

D. **Coordination**: The **Contractor** and **each agency** engaged to perform inspections, tests and similar services **shall coordinate** the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
   1. **The Contractor is responsible for scheduling times** for inspections, tests, taking samples and similar activities.

## 1.3 SUBMITTALS

A. **The independent testing agency** shall submit a certified written report of each inspection, test or similar service, to the Architect, in duplicate
   1. **Submit additional copies** of each written report directly to the governing authority, when the authority so directs.
   2. **Report Data:** Written reports of each inspection, test or similar service shall include, but not be limited to:
      a. Date of issue.
      b. Project title and number.

c. Name, address and telephone number of testing agency.
d. Dates and locations of samples and tests or inspections.
e. Names of individuals making the inspection or test.
f. Designation of the Work and test method.
g. Identification of product and Specification Section.
h. Complete inspection or test data.
i. Test results and an interpretations of test results.
j. Ambient conditions at the time of sample-taking and testing.
k. Name and signature of laboratory inspector.
l. Recommendations on retesting.

## 1.4 QUALITY ASSURANCE

A. **Qualification for Service Agencies**: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
   1. **Each independent inspection and testing agency** engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

## 3.1 TESTS REQUIRED

A. **Tests required may include** but are not limited to the following (see Drawings and associated sections of the specifications):
   1. **Soil Report** per **IBC 2009, 1803.6** and testing per **1806.5.8.** of compacted fill during construction.
   2. **Special Inspections** per **IBC 2009, Section 1704** including fabricators.
      a. **Welding** per **1704.3** and **Table 1704.3.**
      b. **High strength bolts** per **1704.3.3** and **Table 1704.3.**
      c. **Concrete** per **1704.4** and **Table 1704.4.**
      d. **Structural masonry** per **1704.5** and **Table 1704.5.1.**
      e. **Soils** per **1704.7** and **Table 1704.7.**
      f. **Sprayed fire-resistant materials** per **1704.12.**

B. **It is recommended** that the Contractor arrange for soils compaction and any other soils-related testing to be performed by or through the same firm that provided the initial soils investigation data. **A copy** of the **soils investigation data** is included with the Project Manual or **if not included** may be obtained from the **Architect's Office** upon request. The soils investigation is included for reference only.

## 3.2 REPAIR AND PROTECTION

A. **General:** Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.

1. **Protect construction** exposed by or for quality control service activities, and protect repaired construction.
2. **Repair and protection is the Contractor's responsibility**, regardless of the assignment of responsibility for inspection, testing or similar services.

**END OF SECTION**

**SECTION 01 4349**

**MOCK UP REQUIREMENTS**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. **Includes** but is not limited to:
   1. Providing **mock up and control area materials** as described in Contract Documents and in this specification section for the Architect's and Owner's review and acceptance.
   2. **Refer to individual Specification sections** for mock-up requirements in addition to those noted herein.
   3. Without limitation, **mock-ups on site include** the following:
      a. **Mock-ups of individual pieces of work,** as specified in individual Specification sections.
      b. **Field mock-up of exterior wall components**, as described on the Drawings and herein.
      c. **Field mock-ups of interior construction components**, as described on the Drawings and herein. In lieu of a single mock-up, components for review and acceptance may be located in areas designated by the Architect.

B. **Related Sections:**
   1. **Division 1** Section "**Submittals**" for samples.
   2. **Division 1** Section "**Closeout Procedures**" for final cleaning of accepted work that may remain in place.
   3. **Division 1** Section "**Building Enclosure Commissioning Requirements**" for Owner's Building Enclosure Commissioning Agent's (BECA's) responsibilities.
   4. **Individual technical sections** referring to freestanding building envelope mock-up. Failure of a technical section to include reference to the building envelope mock-up shall not cause any material to be excluded from the envelope mock-up when required for proper testing of building enclosure or for determination of overall aesthetic effect of building exterior.

### 1.2 SAMPLES / APPROVALS

A. **Samples**
   1. Where approval of products or materials is specified, submit samples or other evidence of suitability 30 working days minimum prior to the placing of the order for the supply of such products or materials to allow the Architect to approve or comment before manufacture. Do not confirm orders or use products until approval of samples has been obtained. Retain approved samples in a Sample Room; room shall be heated and well lit and kept in a clean condition. Samples shall be used for comparison with the products used in the Project. Remove when no longer required by the Architect.
   2. Where samples of finished work are specified obtain approval of stated characteristic(s) before proceeding with the Work. Retain approved samples in good, clean condition on site for comparison with the project installation. Remove samples which are not part of the finished Project when no longer required.

B. **Mockups**

1. **General:** Allow for all work in connection with the mock-ups as detailed in the Specifications and detailed drawings. Include costs for all mock-ups in the base bid contract. Include material, labor and all other costs in connection with the mock-up including demolition and disposal.
2. **Definitions**:
   a. **Freestanding Mock-ups:** Full-size, physical assemblies that are constructed on-site in a location protected from construction activity.
      1) Freestanding mock-ups are not part of the final construction. Freestanding mock-ups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects, qualities of materials and execution, and to review contruction, coordination, testing,and operation.
      2) Freestanding mock-ups may be tested to verify air- and water-tightness of building components and systems.
      3) Approved freestanding mock-ups establish the standard for judging the Work.
      4) Approved freestanding mock-ups shall remain for balance of construction and be demolished and removed from site upon completion of all related work.
   b. **In-Place Mock-ups**: Full-size, physical assemblies that are constructed in-place and remain part of the final construction.
      1) In-place mock-ups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects, qualities of materials and execution, and to review construction, coordination, testing, and operation.
      2) In-place mock-ups may be tested to verify air-and water-tightness of building components and systems.
      3) Approved in-place mock-ups establish the standard for judging the Work.
      4) Approved in-place mock-ups remain part of the final construction.
3. **Scheduling:** Allow adequate time within the schedule to avoid any delay in the event of the mock-up failing to meet the requirements of the Specification. Failure of the mock-ups to meet the requirements of the specification will not constitute grounds for delay of the project. Coordinate times for review of mock-ups with Owner and Architect.
4. **Locations:** Locate mock-ups as acceptable to the Architect and the Owner.
5. **Testing:**
   a. Testing of exterior mock-ups shall be by Owner's BECA. Tests shall include, but are not limited to:
      1) Quantitative Air Leakage Testing: Testing of the exterior mock-up(s) for static and dynamic air leakage and water infiltration.
      2) Testing of the liquid air/moisture barrier shall occur prior to installation of exterior cladding system.
6. **Exterior Envelope Mock-up:**
   a. **Freestanding Envelope Mock-up:** The sample section of the exterior wall systems shall include, but is not limited to, the following items. See Drawings for detailed mock up requirements.
      1) Stone veneer system, including anchors, flashing, joints and weeps.
      2) Cold-formed wall framing, with sheathing, air and moisture barrier system, and cavity and wall insulation.

3) Aluminum curtainwall, with glazing.
4) Slab-on-grade to wall intersection.
5) Underslab vapor barrier.
6) Composite floor slab to wall intersection.
7) One roof drain installation including roof membrane, main drain piping and secondary drain piping three feet long.
8) Typical parapet cap installation.
9) Footings, foundations, structural steel supports and bracing as required to properly and safely support mock up.
10) Water-resistant closure system to facilitate testing.
11) All miscellaneous components necessary to fully review, test, and accept the wall system for weather- and water-tightness, air infiltration, thermal integrity, structural soundness, and aesthetic quality, including joint sizing and placement, texture and finish of materials, and overall effect.

b. **Mock-up shall be constructed** by the individual trades responsible for each component. General Contractor shall coordinate each trade's work on the mock-up as if coordinating the construction of the building itself.

c. **Mock-up shall be constructed** as a chamber to provide opportunity for testing as noted. Mock-up test chambers from the walls, roof and floor (as needed) that are required to create a fully enclosed structure and are typically installed on the interior surface of the mock-up. The walls of the mock-up from interior to exterior generally consist of wood or steel framing, exterior sheathing, and a fully sealed air barrier. At least one removable and re-sealable 36 inch square access door is required to permit access to the interior of the mock-up. The floor of the mock-up shall be constructed of a reinforced concrete slab/footing. The roof construction is typically similar to the walls. The defined plane of air tightness on the mock-up specimen (air barriers) must be continuously sealed air tight on all sides to the mock-up chamber. Construction of the mock-up and chamber will be witnessed and documented by the BECA.

1) Prior to testing, the BETA will pressurize the test chamber, while simultaneously supplying smoke to the chamber in accordance with ASTM E 1186. Any voids in the chamber and/or interface between the mock-up specimen and chamber as located by smoke infiltration/exfiltration will be identified by the BETA and BECA for the BD to seal air-tight. Air tightness is achieved when no visible smoke is identifiably through the chamber or interface of the chamber with the mock-up specimen.

d. **Exterior mock-up shall be constructed and reviewed sequentially** to assure that individual details (especially where concealed by final assembly) are proper and in conformance with design documents and details. Owner's BECA and Architect shall have full authority to reject any component and require its replacement with new or alternative product when the design criteria are not met.

e. **Assembly of the mock-up** shall be photographically documented by the Contractor and the BECA.

7. **Interior mock-ups:**

a. **Interior mock-ups**: Mock ups shall include framing, acoustic insulation, gypsum board system, door frame connection as well as all finishes including paint, flooring, millwork section and ceiling system.

b. See further information under Control Areas and individual specification sections. For interior mock-ups, the terms "mock-up" and "Control Areas" shall be interchangeable.

C. **Approvals**

1. **Submittals:** Where and to the extent that products or samples are specified to be reviewed; The Contractor will submit information to the Architect as required in the Specification sections prior to using it in a mock up.
   a. Provide large scale drawings for fabrication, installation and erection of all parts of each mock-up. Provide, for review, plans, elevations, and details of anchorage, connections and accessory items.
2. **Mock up Review:** Any action by the Architect must not be taken as approval of products or work unless the Architect so confirms in writing in express terms referring to:
   a. Date of review.
   b. Part of the work inspected.
   c. Respects or characteristics which are approved.
   d. Extent and purpose of the approval.
   e. Any associated conditions.
3. Where the Architect has approved products or work, it is the Contractors' responsibility to **achieve and maintain that standard throughout the whole of the Project**. The Contractor shall prove to the Architect that the products and work meet the approved standard when so required. Products and work which fail to meet the approved standard will be rejected by the Architect or the Owner and replaced at no cost to the Owner. The Contractor shall continue to replace products and work which do not meet the Architect's approval until such time as they do. Failure of the Work to meet the approved standard and the consequential remedial work will not constitute grounds for an extension of time or additional compensation to the Contractor.

D. **Control Areas**

1. For the purpose of agreeing and maintaining quality levels, the **Contractor shall provide typical sample Control areas of completed work** of each finish for approval by the Architect or the Owner prior to undertaking further work of each finish elsewhere within the given building/area.
2. Once the initial control sample of work has been completed and approved, the **Contractor shall focus his attention to advancing the work within the given areas** as listed below, for submission to the Architect or the Owner to confirm that quality levels are in accordance with the drawings and specifications and achieve and maintain the quality level in accordance with their approved sample section.
   a. **For Example:**
      1) Once a sample section of tiling has been approved, the tiling within the given toilet area shall be advanced and completed and approved prior to completing the tiling work within other areas of the building. The other finishes and decorations are to be presented, approved and advanced for completion within the given area prior to completing equivalent work in other rooms/areas.
3. **Care shall be taken with all work which requires stable and controlled environmental conditions** i.e. temperature, humidity, lighting levels. The Contractor shall ensure that these conditions are met prior to the installation of the relevant finish. These conditions may be achieved using temporary means or by using the building's permanent services systems where appropriate. Permanent systems may only be used by prior agreement with the Architect and taking all precautions to ensure safety of operation, maintenance of equipment, extension of warranties to commence from practical completion, replacement of all consumables and returning the equipment and systems to 'as new' condition before Substantial Completion.

a. **For Example:**

1) Woodworking work shall be installed only in accordance with the requirements of the Specifications. Any such work presented to the Architect for approval shall be rejected if the environmental conditions fall short of the required parameters.

E. **Schedule of Control Areas**

1. The **rooms listed below are to be progressively finished**, with each material/finish when approved by the Architect to be identified and protected, remaining visible for inspection to maintain its purpose as an approved sample of workmanship.
   a. **Lobby** including Main Stair
   b. Typical **Office**
   c. Typical **Toilet Room** including plumbing fixtures, and toilet partitions.
   d. **Section of large chilled water, heating hot water, and domestic hot water pipe work installation** incorporating flanges, valves, bends etc. All insulated, color coded and finished to mechanical plant quality.
   e. **Sections of medium pressure and low pressure duct installation** including the flanged connections of sections, joining methods, and sealing methods. The mock-up shall include a branch take-off fitting, a manual balancing damper, an elbow, and a tee.
   f. **Mock-up of a typical fan coil unit** with a meter of ductwork connection on all sides and all hydronic connections. Provide a typical VAV box mock-up.
2. **Arrange inspection** at each stage of completion of the control samples. The control samples shall include all finishes, woodworking, fittings and fitted furnishings, supply and extract grilles, surface mounted and recessed electrical appliances, fire alarm equipment, mechanical system including the VAV boxes, duct work and piping. The mechanical and plumbing do not need to be connected to the mains, boilers or drains etc. but shall include pipe work, ducts and cables etc. within the service riser and suspended ceiling, etc. Lighting shall be connected to either the permanent or temporary power supply. All items of work, finishes and workmanship shall be in accordance with the specifications and the routing and coordination of services and finishes shall be as proposed for the remainder of the work. Obtain Architect's approval of appearance and quality before commencing installation of the remainder of the work. Failure of control samples to meet the approval or subsequent failure to meet approved standards will not constitute grounds for delay and/or loss and expense. Any work carried out which is not to an equivalent standard as the control sample will be deemed to be not in accordance with the specification.

## 1.3 SAMPLES, CONTROL SAMPLES AND MOCK-UPS

A. The Contractor shall make allowance for the cost of the provision of samples, sample rooms, control areas and mock-ups, which are required to be provided and constructed in advance of the remainder of the Project. The Contactor shall incorporate the dates for provision of samples, control samples, etc. in the CPM schedule and give the Architect a minimum of 14 working days notice of the completion of control samples and mock-ups.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. See individual sections for all systems and finishes required for each room.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. See individual sections for all systems and finishes required for each room.

### 3.2 PROTECTION

A. Protect finished areas of the building from damage, replace any damaged or soiled work that cannot be corrected in place.

**END OF SECTION**

## SECTION 01 5000

## TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

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

B. The **Contractor shall reimburse the Owner** an amount, as **indicated in parentheses ( )** below, for every day that the indicated service has not been provided at the project site, **beginning one (1) week after receipt of Notice to Proceed**, unless noted otherwise.

C. **Temporary utilities include**, but are not limited to, the following:
1. Sewers and drainage.
2. Water service and distribution. ($20.00 per day)
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities. ($25.00 per day)
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service. ($20.00 per day)
7. Lighting. ($20.00 per day)
8. Telephone service. ($10.00 per day)
9. Internet service. ($10.00 per day)
10. Facsimile machine. ($10.00 per day)

D. **Support facilities** include, but are not limited to, the following:
1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Project identification and temporary signs.
4. Waste disposal facilities.
5. Field offices. ($100.00 per day)
6. Storage and fabrication sheds. ($100.00 per day)
7. Lifts and hoists.
8. Temporary elevator usage.
9. Temporary stairs.
10. Construction aids and miscellaneous services and facilities.
11. First aid station. ($25.00 per day)

E. **Security and protection facilities** include, but are not limited to, the following:
1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.
6. Security enclosure and lockup.
7. Barricades, warning signs, and lights.
8. Covered walkways.
9. Temporary enclosures.
10. Temporary partitions.
11. Fire protection.

F. **Related Sections** include the following:
1. **Division 1** Section "**Submittal Procedures**" for procedures for submitting copies of implementation and termination schedule and utility reports.
2. **Division 1** Section "**Execution Requirements**" for progress cleaning requirements.
3. **Divisions 2 through 33** for temporary heat, ventilation, and humidity requirements for products in those Sections.

## 1.3 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.

## 1.4 USE CHARGES

A. **General:** Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. 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.

B. **Water and Sewer Service from Existing System:** Contractor shall bear all costs for water and sewer service. Contractor shall install meters for measuring use of utilities purchased from Weber State University. Meter readings, in the presence of the Owner's Project Manager, shall be taken at the beginning and end of project use of utilities for the purpose of determining overall value of utility usage. Provide connections and extensions of services as required for construction operations.

C. **Electric Power Service from Existing System:** Contractor shall bear all costs for electrical service. Contractor shall install meters for measuring use of utilities purchased from Weber State University. Meter readings, in the presence of the Owner's Project Manager, shall be taken at the beginning and end of project use of utilities for the purpose of determining overall value of utility usage. Provide connections and extensions of services as required for construction operations.

D. **Gas Service from Existing System:** Contractor shall bear all costs for natural gas service. Contractor shall install meters for measuring use of utilities purchased from Weber State University. Meter readings, in the presence of the Owner's Project Manager, shall be taken at the beginning and end of project use of utilities for the purpose of determining overall value of utility usage. Provide connections and extensions of services as required for construction operations. Provide connections and extensions of services as required for construction operations.

E. Contractor shall conserve usage of utilities. Excessive use or wasting of utilities will not be tolerated.

## 1.5 QUALITY ASSURANCE

A. **Standards**: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
   1. **Trade Jurisdictions**: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
   2. **Electric Service**: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

## 1.6 PROJECT CONDITIONS

A. **Temporary Utilities**: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
   1. 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.

B. **Conditions of Use**: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
   1. Keep temporary services and facilities clean and neat.
   2. Relocate temporary services and facilities as required by progress of the Work.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

A. **General**: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. **Chain-Link Fencing**: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; **minimum 6 feet (1.8 m) high** with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails. Provide concrete bases of supporting posts.

C. **Lumber and Plywood**: Comply with requirements in Division 6 Section "Miscellaneous Carpentry."

D. **Tarpaulins**: Fire-resistive labeled with flame-spread rating of 15 or less.

E. **Water**: Potable.

## 2.2 EQUIPMENT

A. **General**: Provide equipment suitable for use intended.

B. **Field Offices**: Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. **Fire Extinguishers**: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
   1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. **Self-Contained Toilet Units**: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. **Drinking-Water Fixtures**: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
   1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7.2 to 12.7 deg C).

F. **Heating Equipment**: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

G. **Electrical Outlets**: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

H. **Power Distribution System Circuits**: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

# 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.

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

## 3.2 TEMPORARY UTILITY INSTALLATION

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

1. **Arrange with utility company, Owner, and existing users** for time when service can be interrupted, if necessary, to make connections for temporary services.
2. **Provide adequate capacity at each stage of construction**. Before temporary utility is available, provide trucked-in services.
3. **Obtain easements** to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. **Sewers and Drainage**: Provide temporary connections to remove effluent that can be discharged lawfully.

1. **Filter out excessive soil,** construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
2. **Connect temporary sewers** to municipal system as directed by sewer department officials.
3. **Maintain temporary sewers** and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
4. **Provide temporary filter beds**, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. **Water Service**: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

1. **Provide rubber hoses** as necessary to serve Project site.
2. **As soon as water is required at each level**, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
3. **Where installations below an outlet** might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

D. **Sanitary Facilities**: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. **Disposable Supplies**: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. **Toilets:** Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.

3. **Wash Facilities:** Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
   a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

E. **Heating and Cooling**: 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. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
   1. **Maintain a minimum temperature** of 50 deg F (10 deg C) in permanently enclosed portions of building for normal construction activities, and 65 deg F (18.3 deg C) for finishing activities and areas where finished Work has been installed.

F. **Ventilation and Humidity Control**: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified 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.

G. **Electric Power Service**: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
   1. **Install power distribution wiring overhead** and rise vertically where least exposed to damage.
   2. **Connect temporary service to Owner's existing power** source, as directed by electric company officials.

H. **Electric Distribution**: Provide receptacle outlets adequate for connection of power tools and equipment.
   1. **Provide waterproof connectors** to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
   2. **Provide warning sign**s at power outlets other than 110 to 120 V.
   3. **Provide metal conduit**, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
   4. **Provide metal conduit** enclosures or boxes for wiring devices.
   5. **Provide 4-gang outlets**, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

I. **Lighting**: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
   1. **Install and operate temporary lighting** that fulfills security and protection requirements without operating entire system.
   2. **Provide one 100-W incandescent lamp per 500 sq. ft.** (45 sq. m), uniformly distributed, for general lighting, or equivalent illumination.

3. **Provide one 100-W incandescent lamp every 50 feet** (15 m) in traffic areas.
4. **Provide one 100-W incandescent lamp per story in stairways** and ladder runs, located to illuminate each landing and flight.
5. **Install exterior-yard site lighting** that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

J. **Telephone Service**: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
1. Provide additional telephone lines for the following:
   a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
   b. Provide a dedicated telephone line for each facsimile machine and computer with modem in each field office.
   c. Provide a separate telephone line for Owner's use.
   d. Install a telephone on every second or third story of construction.
2. **At each telephone,** post a list of important telephone numbers.
   a. Police and fire departments.
   b. Ambulance service.
   c. Contractor's home office.
   d. Architect's office.
   e. Engineers' offices.
   f. Owner's office.
   g. Principal subcontractors' field and home offices.
3. **Provide an answering machine or voice-mail service** on Superintendent's telephone.
4. **Provide a portable cellular telephone for Superintendent's** use in making and receiving telephone calls when away from field office.
5. **Provide a computer and printer** for Contractor's, Owner's, Architect's and other members of the Construction Team's use in making and receiving correspondence from the Architect and subcontractors. Provide with internet-enabled routing and wireless access for e-mail communication and use of wireless devices. Computer shall conform to the following:
   a. Processor: Intel Core2 Duo or Intel i3, i5, i7, 2.5 GHz processing speed.
   b. Memory: 4 gigabyte.
   c. Disk Storage: 250 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
   d. Display: 22-inch (560-mm) LCD monitor with 256-Mb dedicated video RAM.
   e. Full-size keyboard and mouse.
   f. Network Connectivity: 10/100BaseT Ethernet. If encrypted, provide both SSID and encryption password to Architect and Owner.
   g. Operating System: Microsoft Windows XP Professional or Microsoft Windows 7
   h. Productivity Software:
      1) Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
      2) Adobe Reader 9.0 or higher.
      3) WinZip 7.0 or higher.
   i. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.

j. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.5 Mbps upload and 3 Mbps download speeds at each computer.

k. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

l. Backup: External hard drive, minimum 1 TB, with automated backup software providing daily backups

## 3.3 SUPPORT FACILITIES INSTALLATION

A. **General**: Comply with the following:

1. **Locate field offices**, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. **Provide incombustible construction for offices**, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
3. **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 to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 inches (150 mm).
2. Provide gravel paving course of subbase material not less than 3 inches (75 mm) thick; roller compacted to a level, smooth, dense surface.
3. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. **Traffic Controls**: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

D. **Dewatering Facilities and Drains**: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. 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 property nor endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
3. Remove snow and ice as required to minimize accumulations.

E. **Project Identification and Temporary Signs**: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
2. Prepare temporary signs to provide directional information to construction personnel and visitors.

3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
5. Provide one 72 inches high x 96 inches wide project sign with text as follows:
   a. Name of Project.
   b. DFCM logo.
   c. Weber State University Logo.
   d. Name of Architect.
   e. Architect's Logo.
   f. Name of Contractor.
   g. Contractor's Logo.
   h. Additional lines as directed by the Architect and Owner.
   i. Sign to be approved by the Architect.

F. **Waste Disposal Facilities**:
1. Establish a system for daily collection and disposal of waste or extraneous materials from all construction areas on site that may present a hazard to the project, its craftsmen and the expeditious construction of the work. The Contractor shall provide to the Owner a satisfactory method to assure clean-up is performed in a timely and expeditious fashion. Enforce requirements strictly. Do not hold collected materials at the site longer than 7 days during normal weather or 3 days when the daily temperature is expected to rise above 80 degrees F. Handle waste materials that are hazardous, dangerous, or unsanitary separately from other inert waste by containerizing appropriately. Dispose of waste material in a lawful manner.
   a. Burying or burning of waste materials on the site will not be permitted.
   b. Washing waste materials down sewers or into waterways will not be permitted.
   c. Provide rodent proof containers located on each floor level of construction work, to encourage depositing of lunch garbage and similar wastes by construction personnel.
   d. Use of the University dumpsters or disposal containers is strictly prohibited.
2. The Owner reserves the right to withhold payments and perform the clean-up, if necessary, at the expense of the Contractor, if satisfactory clean-up efforts are not performed in a timely fashion.

G. **Common-Use Field Office**: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 12 persons at Project site. Keep office clean and orderly.
1. **Furnish and equip offices as follows:**
   a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
   b. Provide a room of not less than 240 sq. ft. (18.0 sq. m) for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot- (1.2-m-) square tack board.
2. Provide resilient floor covering and painted gypsum wallboard walls and acoustical ceiling. Provide operable windows with adjustable blinds and insect screens.

3. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F (20 deg C). Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F (23 deg C).
4. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot (4-m) intervals, 1 per wall in each room.
5. Owner's Inspector's Office: Contractor shall provide a separate office/trailer, minimum 8 feet x 12 feet, to be used by the owner's inspector. Office shall be equipped with a separate phone line, fax line, bottled water facility, lighting, heat, cooling and minimum 6 foot long plan table. Entrance to office shall be controlled by the owner.

H. **Storage and Fabrication Sheds**: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

I. **Lifts and Hoists**: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. **Temporary Stairs**: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

## 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. Avoid using tools and equipment that produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. **Stormwater Control**: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

C. **Tree and Plant Protection**: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

D. **Pest Control**: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service 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.

E. **Site Enclosure Fence**: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
   1. **Set** fence posts **in concrete** bases.
   2. **Provide gates** in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
   3. **Maintain security** by limiting number of keys and restricting distribution to authorized personnel.

F. **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.

G. **Barricades, Warning Signs, and Lights**: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
   1. **For safety barriers**, sidewalk bridges, and similar uses, provide minimum 5/8-inch- (16-mm-) thick exterior plywood.

H. **Covered Walkway**: Where required, erect a structurally adequate, protective, covered walkway for passage of persons along adjacent public street. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

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 weathertight enclosure for building exterior.
   1. **Where heating or cooling** is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
   2. **Vertical Openings**: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.
   3. **Horizontal Openings**: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
   4. **Install tarpaulins** securely using fire-retardant-treated wood framing and other materials.
   5. **Where temporary wood** or plywood enclosure exceeds 100 sq. ft. (9.2 sq. m) in area, use fire-retardant-treated material for framing and main sheathing.

J. **Temporary Partitions**: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
   1. **Construct dustproof partitions** of not less than nominal 4-inch (100-mm) studs, 5/8-inch (16-mm) gypsum wallboard with joints taped on occupied side, and 1/2-inch (13-mm) fire-retardant plywood on construction side.
   2. **Insulate partitions** to provide noise protection to occupied areas.
   3. **Seal joints and perimeter**. Equip partitions with dustproof doors and security locks.
   4. **Protect air-handling** equipment.
   5. **Weatherstrip** openings.

K. **Temporary Fire Protection**: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. **Provide fire extinguishers**, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
   a. **Field Offices**: Class A stored-pressure water-type extinguishers.
   b. **Other Locations**: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
   c. **Locate fire extinguishers** where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
2. **Store combustible materials** in containers in fire-safe locations.
3. **Maintain unobstructed access to fire extinguishers**, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. **Supervise welding operations**, combustion-type temporary heating units, and similar sources of fire ignition.
5. **Permanent Fire Protection**: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. **Develop and supervise an overall fire-prevention** and first-aid fire-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.
7. **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.

## 3.5 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. Protect from damage caused by freezing temperatures and similar elements.

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

C. **Temporary Facility Changeover**: Except for using permanent fire protection as soon as available, 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 the **property of Contractor**. Owner reserves right to take possession of Project identification signs.
2. **Remove temporary paving** not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. **At Substantial Completion**, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

**END OF SECTION**

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# SECTION 01 6000

# PRODUCT REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following administrative and procedural requirements: 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 Sections** include the following:
1. **Division 1** Section "**Definitions and Standards**" for applicable industry standards for products specified.
2. **Division 1** Section "**Closeout Procedures**" for submitting warranties for contract closeout.
3. Divisions 2 through 33 **Sections** for specific requirements for **warranties** on products and installations specified to be warranted.

### 1.3 DEFINITIONS

A. **Products**: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. **Named Products**: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. **New Products:** Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products. Only new products are allowed to be used unless directed by the Architect in writing.
3. **Comparable Product**: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

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

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

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

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

## 1.4 SUBMITTALS

A. **Product List**: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. **Coordination**: Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. **Form**: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.
      h. Identification of items that require early submittal approval for scheduled delivery date.
   3. **Initial Submittal**: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
      a. **At Contractor's option**, initial submittal may be limited to product selections and designations that must be established early in Contract period.
   4. **Completed List**: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   5. **Architect's Action**: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. **Substitution Requests**: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. **Substitution Request Form**: Use **CSI Form 13.1A**.
   2. **Documentation**: Show compliance with requirements for substitutions and the following, as applicable:
      a. **Statement** indicating why specified material or product cannot be provided.
      b. **Coordination information**, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

c. **Detailed comparison** of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. **Product Data**, including drawings and descriptions of products and fabrication and installation procedures.
e. **Samples**, where applicable or requested.
f. **List of similar installations** for completed projects with project names and addresses and names and addresses of architects and owners.
g. **Material test reports** from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. **Research/evaluation reports** evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. **Detailed comparison** of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. **Cost information**, including a proposal of change, if any, in the Contract Sum.
k. **Contractor's certification** that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. **Contractor's waiver of rights** to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. **Architect's Action**: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution **within 15 business days** of receipt of request, or **7 business** days of receipt of additional information or documentation, whichever is later.
   a. **Form of Acceptance**: Change Order.
   b. **Use product specified** if Architect cannot make a decision on use of a proposed substitution within time allocated.

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

## 1.5 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. **Each contractor is responsible** for providing products and construction methods compatible with products and construction methods of other contractors.
   2. **If a dispute arises** between contractors over concurrently selectable but incompatible products, **Architect will determine** which products shall be used.

## 1.6 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.
   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.
   5. **Store products** to allow for inspection and measurement of quantity or counting of units.
   6. **Store materials** in a manner that will not endanger Project structure.
   7. **Store products** that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   8. **Comply with product manufacturer's written instructions** for temperature, humidity, ventilation, and weather-protection requirements for storage.
   9. **Protect stored products** from damage.

## 1.7 PRODUCT WARRANTIES

A. **General**: 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.

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. Refer to **Divisions 2** through **33 Sections** for specific content requirements and particular requirements for submitting special warranties.

C. **Submittal Time**: Comply with requirements in **Division 1** Section "**Closeout Procedures**."

## PART 2 - PRODUCTS

### 2.1 PRODUCT OPTIONS

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

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.
6. **Descriptive, performance, and reference standard requirement**s in the Specifications establish "**salient characteristics**" of products.
7. **Or Equal**: Where products are specified by name and accompanied by the term "**or equal**" or "or **approved equal**" or "**or approved**," comply with provisions in "**Comparable Products**" Article to obtain approval for use of an unnamed product.

B. **Product Selection Procedures**: Procedures for product selection include the following:

1. **Product**: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
   a. **Substitutions** may be considered, unless otherwise indicated.
2. **Manufacturer/Source**: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
   a. **Substitutions** may be considered, unless otherwise indicated.
3. **Products**: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   a. **Substitutions** may be considered, unless otherwise indicated.
4. **Manufacturers**: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   a. **Substitutions** may be considered, unless otherwise indicated.
5. **Available Products**: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. **Available Manufacturers**: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

7. **Product Options**: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. **Basis-of-Design Products**: Where Specification paragraphs or subparagraphs titled "**Basis-of-Design Products**" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "**Comparable Products**" Article to obtain approval for use of an unnamed product.
   a. **Substitutions** may be considered, unless otherwise indicated.
9. **Visual Matching Specification**: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
   a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. **Visual Selection Specification**: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
   a. **Standard Range**: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
   b. **Full Range**: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

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

B. **Conditions**: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   1. Requested substitution offers Owner a **substantial advantage** in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   2. Requested substitution **does not require extensive revisions** to the Contract Documents.
   3. Requested substitution is **consistent** with the **Contract Documents** and will produce indicated results.

4. Substitution request is **fully documented** and properly submitted.
5. Requested substitution will **not adversely affect** Contractor's **Construction Schedule**.
6. Requested substitution has received **necessary approvals** of **authorities having jurisdiction**.
7. Requested substitution is **compatible** with other portions of the Work.
8. Requested substitution has been **coordinated** with other portions of the Work.
9. Requested substitution provides **specified warranty**.
10. If requested substitution involves **more than one contractor**, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## 2.3 COMPARABLE PRODUCTS

A. **Where products** or manufacturers are **specified by name**, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
1. **Evidence** that the proposed product **does not require extensive revision**s to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. **Detailed comparison** of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. **Evidence** that proposed product provides **specified warranty**.
4. **List** of **similar installations** for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. **Samples,** if requested.

## PART 3 - EXECUTION (NOT USED)

**END OF SECTION**

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# SECTION 01 7300

# EXECUTION REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** general procedural requirements governing **execution of the Work** including, but not limited to, the following:
1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. **Related Sections** include the following:
1. **Division 1** Section "**Project Management and Coordination**" for procedures for coordinating field engineering with other construction activities.
2. **Division 1** Section "**Submittals**" for administrative submittals and also product and procedural submittals.
3. **Division 2** Section "**Cutting and Patching**" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. **Division 1** Section "**Closeout Procedures**" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

### 1.3 SUBMITTALS

A. **Qualification Data**: For land surveyor/professional engineer to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. **Certificates**: Submit certificate signed by land surveyor/professional engineer certifying that location and elevation of improvements comply with requirements.

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

D. **Certified Surveys**: Submit two copies signed by land surveyor/professional engineer.

E. **Final Property Survey**: Submit three copies and an electronic copy in pdf format showing the Work performed and record survey data.

## 1.4 QUALITY ASSURANCE

A. **Land Surveyor Qualifications**: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

## PART 2 - PRODUCTS (NOT USED)

## 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 sitework, 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. Provide at least **five (5) working days notification** before beginning any activity that may in any way damage or disrupt utilities.
   3. **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. **Written Report**: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
      a. Description of the Work.
      b. List of detrimental conditions, including substrates.
      c. List of unacceptable installation tolerances.
      d. Recommended corrections.
   2. **Verify compatibility** with and suitability of substrates, including compatibility with existing finishes or primers.
   3. **Examine roughing-in** for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   4. **Examine walls, floors, and roofs** for suitable conditions where products and systems are to be installed.
   5. **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 Interruptions**: Do not interrupt utilities serving facilities occupied unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. **Notify Architect and Owner** not less than **seven (7) business days** in advance of proposed utility interruptions.
   2. **Do not proceed** with **utility interruptions** without Architect's and Owner's written permission.

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

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

D. **Review of Contract Documents and Field Conditions**: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

E. **A minimum of three (3) working days** will be given to the Architect and Owner prior to scheduling the following activities:
   1. Mobilization
   2. Construction Start-up
   3. All required inspections involving Owner's Facilities Management (FM) Shop personnel

## 3.3 CONSTRUCTION LAYOUT

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

B. **General**: Engage a land surveyor/professional engineer to lay out the Work using accepted surveying practices.
   1. **Establish benchmarks** and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. **Establish dimensions** within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   3. **Inform installers** of lines and levels to which they must comply.
   4. Check the location, level and plumb, of every major element as the Work progresses.
   5. **Notify Architect** when deviations from required lines and levels exceed allowable tolerances.
   6. **Close site surveys** with an error of closure equal to or less than the standard established by authorities having jurisdiction.

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

D. **Building Lines and Levels**: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. **Record Log**: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

## 3.4 FIELD ENGINEERING

A. **Identification**: Owner will identify existing benchmarks, control points, and property corners.

B. **Reference Points**: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. **Do not change or relocate existing benchmarks** or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. **Replace lost or destroyed permanent benchmarks** and control points promptly. Base replacements on the original survey control points.

C. **Benchmarks**: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. **Record benchmark locations**, with horizontal and vertical data, on Project Record Documents.
   2. **Where the actual location** or elevation of layout points **cannot be marked**, provide temporary reference points sufficient to locate the Work.
   3. **Remove temporary reference points** when no longer needed. Restore marked construction to its original condition.

D. **Certified Survey**: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. **Final Property Survey**: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor/professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
   1. **Show boundary lines**, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
   2. **Recording**: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

## 3.5 INSTALLATION

A. **General**: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. **Make vertical work plumb** and make horizontal work level.
   2. **Where space is limited**, install components to maximize space available for maintenance and ease of removal for replacement.
   3. **Conceal pipes**, ducts, and wiring in finished areas, unless otherwise indicated.
   4. **Maintain minimum headroom clearance** as indicated in spaces without a suspended ceiling.

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. **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.

G. **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.

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

I. **Verification of Materials:** The General Contractor or Construction Manager shall verify that materials installed on the project conform to the shop drawings and samples reviewed by the Architect. Sets of reviewed samples and submittals shall be maintained at the Project site and physically compared to labels, tags and other identifications on products delivered to site prior to installation. Products differing in any way from the reviewed samples or submittals shall be rejected.

J. **Certification of Under-Slab Construction**: Before pouring grade level slab, provide certification of completion of all under-slab construction.
   1. Certification form follows this section.

K. **Lock-Out, Tag-Out Procedures**: Contractors performing work on Campus will be required to follow OSHA-approved lockout, tag-out procedures. Such procedures will be applied but not limited to:
1. All electrical main and distribution systems.
2. Motor disconnects.
3. High and low pressure steam valves.
4. Potable water distribution system valves.
5. Irrigation system main line valves.

L. **Utility Notification**: A minimum of seven (7) working days will be given to the Owner prior to shutting down any campus utility.

M. **Emergency Response**: During the construction phase, the Contractor will be held responsible for immediate response to emergency situations caused by work associated with the project, or negligence and/or oversight on his part. Situations requiring emergency response by Owner's Facilities Management personnel for the protection of the University will be billed at the rate of **$50.00 per hour**, plus parts and materials. A two hour minimum charge will apply to all response calls after normal business hours. Requests for other assistance from FM personnel in dealing with situations encountered as part of the Contract Documents will be billed at $50.00 per hour.

## 3.6 CONTRACTOR USE OF BUILDING EQUIPMENT

A. **Contractor may use equipment** such as electric motors, blowers, heat exchangers, filters, lighting fixtures, etc., **with the written permission** of the University. As each piece of equipment is used (such as electric motors and blowers) maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the time used, maintenance procedures, and of any difficulty experienced with the equipment. These Contractors' records on the equipment are to be submitted to the Owner upon acceptance. Depending on the length of time used, it may be required that the Contractor replace in a new condition certain expendables of the equipment, such as belts, filter media, fluorescent tubes and/or incandescent globes. Wearing surfaces (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. Contractor is responsible for all utilities services. The guarantee period for the equipment shall begin with final acceptance by the University, and not at the time the Contractor starts using the equipment.

## 3.7 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.
1. **Comply** with requirements in **NFPA 241** for removal of combustible waste materials and debris.
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 (27 deg C).
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**: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. **Cutting and Patching**: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
   1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. **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.

I. **Protection**: 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.

J. **Maintenance**: 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 smooth operation without damaging effects.

K. **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.

## 3.8 DUST CONTROL

A. **The Contractor** shall be responsible to provide continuous (7 days per week, 24 hours per day) fugitive dust control measures within the limits of the construction site, related sites and adjacent streets and roads. Dust control shall be provided for, but not be specifically limited to, the stabilization of unpaved roads, haul roads, access roads, spoil sites, borrow and material sources, excavations, embankments, stockpiles, and all other areas which become potential sources of dust as a result of construction activities.

B. **Contractor's dust control measures** shall maintain compliance with the **General Utah Air Pollution Regulations**, R446 - Utah Air Conservation Regulations, Section 4.5, Fugitive Emissions, applicable County Air Pollution Control Ordinances, and as directed by the Architect. Dust control measures shall include but not be limited to the following:
   1. **Wetting of surfaces** with water as appropriate.
   2. **Minimizing surface disturbances**.

C. **In order to control fugitive dust emissions**, Contractor shall apply the following procedures and techniques:
   1. **Cover loads of materials**, debris and waste materials taken from construction sites as needed to suppress dust during transit.
   2. **Water down** or apply other approved dust control measures to the construction site, haul roads and public access roads as needed to suppress dust.
   3. **All mud and dirt shall be removed** from vehicles prior to entering a paved or graveled area or road. Any mud or dirt that is carried out onto paved or graveled surfaces shall be removed from surfaces immediately and no less than daily.

## 3.9 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 1 Section "Quality Requirements."

## 3.10 PROTECTION OF INSTALLED CONSTRUCTION

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

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

## 3.11 CORRECTION OF THE WORK

A. **Repair or remove** and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 2 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**

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# SECTION 01 7419

# CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes **administrative and procedural requirements** for the following:
   1. **Salvaging** nonhazardous demolition and construction waste.
   2. **Recycling** nonhazardous demolition and construction waste.
   3. **Disposing** of nonhazardous demolition and construction waste.

B. **Related Requirements:**
   1. **Division 2 S**ection "**Selective Demolition**" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
   2. **Division 4** Section "**Unit Masonry**" for disposal requirements for masonry waste.
   3. **Division 4** Section "**Dimension Stone Cladding**" for disposal requirements for excess stone and stone waste.
   4. **Division 31** Section "**Site Clearing**" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

### 1.3 DEFINITIONS

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

B. **Demolition Waste:** Building and site improvement materials resulting from demolition or selective demolition operations.

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

D. **Recycle:** Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. **Salvage:** Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. **Salvage and Reuse:** Recovery of demolition or construction waste and subsequent incorporation into the Work.

## 1.4 PERFORMANCE REQUIREMENTS

A. **General:** Achieve end-of-Project rates for **salvage/recycling of 50 percent by weight of total non-hazardous solid waste** generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. **Demolition Waste:**
   - a. Site-clearing waste.
   - b. Asphalt paving.
   - c. Concrete.
   - d. Concrete reinforcing steel.
   - e. Brick.
   - f. Concrete masonry units.
   - g. Plywood and oriented strand board.
   - h. Structural and miscellaneous steel.
   - i. Rough hardware.
   - j. Roofing.
   - k. Insulation.
   - l. Doors and frames.
   - m. Door hardware.
   - n. Windows.
   - o. Glazing.
   - p. Metal studs.
   - q. Gypsum board.
   - r. Acoustical tile and panels.
   - s. Carpet.
   - t. Equipment.
   - u. Cabinets.
   - v. Plumbing fixtures.
   - w. Piping.
   - x. Supports and hangers.
   - y. Valves.
   - z. Sprinklers.
   - aa. Mechanical equipment.
   - ab. Refrigerants.
   - ac. Electrical conduit.
   - ad. Copper wiring.
   - ae. Lighting fixtures.
   - af. Lamps.
   - ag. Ballasts.
   - ah. Electrical devices.
   - ai. Switchgear and panelboards.
   - aj. Transformers.
2. **Construction Waste:**
   - a. Masonry and CMU.
   - b. Lumber.
   - c. Wood sheet materials.
   - d. Wood trim.
   - e. Metals.
   - f. Roofing.
   - g. Insulation.

h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1) Paper.
   2) Cardboard.
   3) Boxes.
   4) Plastic sheet and film.
   5) Polystyrene packaging.
   6) Wood crates.
   7) Plastic pails.

## 1.5 ACTION SUBMITTALS

A. **Waste Management Plan:** Submit 3 copies of plan within 7 days of date established for commencement of the Work.

## 1.6 INFORMATIONAL SUBMITTALS

A. **Waste Reduction Progress Reports:** Concurrent with each Application for Payment, submit 3 copies of report. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons (tonnes).
   4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
   5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
   6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. **Waste Reduction Calculations:** Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. **Records of Donations:** Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. **Records of Sales:** Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

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

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

G. **Qualification Data:** For waste management coordinator and refrigerant recovery technician.

H. **Statement of Refrigerant Recovery:** Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

## 1.7 QUALITY ASSURANCE

A. **Refrigerant Recovery Technician Qualifications:** Certified by EPA-approved certification program.

B. **Regulatory Requirements:** Comply with hauling and disposal regulations of authorities having jurisdiction.

C. **Waste Management Conference:** Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

## 1.8 WASTE MANAGEMENT PLAN

A. **General:** Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

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

C. **Waste Reduction Work Plan:** List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

A. **General:** Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with operation, termination, and removal requirements in Division 01 Section "Temporary Facilities and Controls."

B. **Waste Management Coordinator:** Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. **Training:** Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. **Site Access and Temporary Controls:** Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Sections “Summary” and "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

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

B. **Preparation of Waste:** Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

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 according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

## 3.3 RECYCLING CONSTRUCTION WASTE

A. **Packaging:**

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

B. **Wood Materials:**

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

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

## 3.4 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:** Remove waste materials from Owner's property and legally dispose of them.

**END OF SECTION**

# SECTION 01 7700

# CLOSEOUT PROCEDURES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. **Related Sections** include the following:
1. **Division 1** Section "**Payment Procedures**" for requirements for Applications for Payment for Substantial and Final Completion.
2. **Division 1** Section "**Execution Requirements**" for progress cleaning of Project site.
3. **Division 1** Section "**Operation and Maintenance Data**" for operation and maintenance manual requirements.
4. **Divisions 2 through 33 Sections** for specific closeout and special cleaning requirements for products of those Sections.

### 1.3 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.
   a. Provide documentation of the Owner's receipt of extra materials (attic stock). Documentation shall include:
      1) Product and quantity furnished.
      2) Location where materials are stored in the facility or where delivered to the Owner.
      3) Date when delivered to Owner.
      4) Owner's signed acknowledgment that materials have been received.
      5) Signature of Contractor that all specified extra materials have been furnished to the Owner.
   b. Include copy of extra material documentation in Operation and Maintenance manual
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.
9. **Submit test/adjust/balance** records.
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.

## 1.4 FINAL COMPLETION

A. **Preliminary Procedures**: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. **Submit a final Application for Payment** according to **Division 1** Section "**Payment Procedures**."
   2. **Submit certified copy** of 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. **Submit pest-control** final inspection report and warranty.
   5. **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. Architect 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.

C. **Additional Review Fees**: Should Architect perform more than one additional review, or extend it's construction period services more than 15 business days beyond the scheduled completion date, due to the failure of the Contractor's work to comply with the claims of status or completion made by the Contractor, Owner will compensate Architect for such additional/ extended services at the rate of $500.00 per day. The Owner shall then deduct the amount of such compensation from the final payment to the Contractor.

## 1.5 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 Contractor 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 Architect.
   d. Name of Contractor.
   e. Page number.

B. **A minimum of three (3) working days** will be given to the Architect and Owner prior to scheduling the following activities:

1. Workers arriving on-site for completion of Punch List work.

## 1.6 PROJECT RECORD DOCUMENTS

A. **General**: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. **Record Drawings**: Maintain and submit **two sets** of blue- or black-line white prints of Contract Drawings and Shop Drawings. Furnish an **electronic copy** of documents in format approved by the Owner, bookmarked for ready access with same name as actual drawing sheet.

1. **Mark Record Prints** to show the **actual** installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
   a. **Give particular attention** to information on **concealed elements** that cannot be readily identified and recorded later.
   b. **Accurately record** information in an understandable drawing technique.

c. **Record data as soon as possible** after obtaining it; do not wait until end of project. Record and check the markup before enclosing concealed installations.

d. **Mark Contract Drawings or Shop Drawings**, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

e. **Content**: Types of items requiring marking include, but are not limited to:

1) **Dimensional changes** to Drawings.
2) **Revisions to details** shown on Drawings.
3) **Depths of foundations** below first floor.
4) **Locations and depths of underground utilities.**
5) Revisions to **routing of piping and conduits**.
6) Revisions to **electrical circuitry**.
7) Actual **equipment locations**.
8) **Duct size** and routing.
9) Locations of **concealed internal utilities**.
10) **Changes** made by **Change Order or Construction Change Directive**.
11) **Changes** made following **Architect's written orders**.
12) **Details not on the original Contract Drawings**.
13) **Field records** for variable and concealed conditions.
14) Record information on the **Work that is shown only schematically**.

2. **Mark record sets with erasable**, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. **Mark important additional information** that was either shown schematically or omitted from original Drawings.
4. **Note Construction Change Directive numbers**, Change Order numbers, alternate numbers, and similar identification where applicable.
5. **Identify and date each Record Drawing**; include the designation **"PROJECT RECORD DRAWING"** in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. **Record Specifications**: Submit **two copies** of Project's Specifications, including addenda and contract modifications and one electronic copy, bookmarked. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. **Give particular attention to information on concealed products** and installations that cannot be readily identified and recorded later.
2. **Mark copy with the proprietary name** and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. **Note related Change Orders**, Record Drawings, and Product Data, where applicable.

D. **Record Product Data**: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
   1. **Give particular attention to information on concealed products** and installations that cannot be readily identified and recorded later.
   2. **Include significant changes** in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. **Note related Change Orders**, Record Drawings, and Record Specifications, where applicable.

E. **Miscellaneous Record Submittals**: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## 1.7 OPERATION AND MAINTENANCE MANUALS

A. **Assemble a complete set of operation and maintenance data** indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
   1. **Operation Data**:
      a. Emergency instructions and procedures.
      b. System, subsystem, and equipment descriptions, including operating standards.
      c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
      d. Description of controls and sequence of operations.
      e. Piping diagrams.
   2. **Maintenance Data**:
      a. Manufacturer's information, including list of spare parts.
      b. Name, address, and telephone number of Installer or supplier.
      c. Maintenance procedures.
      d. Maintenance and service schedules for preventive and routine maintenance.
      e. Maintenance record forms.
      f. Sources of spare parts and maintenance materials.
      g. Copies of maintenance service agreements.
      h. Copies of warranties and bonds.

B. **Organize operation and maintenance manuals** into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "**OPERATION AND MAINTENANCE MANUAL**," Project name, and subject matter of contents.
   1. Furnish **four (4) complete sets** of Operational and Maintenance manuals.

C. **Operation & Maintenance Manual, Commissioning DVD**

1. An **intuitive DVD instructional manual** shall be provided to give the Owner's representative the information they need to care, adjust, maintain and operate all of the equipment within the building, to include but not limited to, the heating, air conditioning, ventilating, plumbing, automatic temperature control systems, audio visual equipment, electrical equipment and building products requiring maintenance.
2. **An orientation date shall be set up** to instruct the Owner's representative on the use of the operation and maintenance DVD A written report specifying times, dates, and names of personnel instructed shall be forwarded to the Owner's representative.
3. **DVD Manual** preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete DVD operation and maintenance manual. Qualifications shall be submitted for approval.
4. **All DVDs shall be authored with Adobe Acrobat**. The authoring shall, but not be limited to include the following:
   a. **All design drawings and documentation shall be included** on the DVD in a PDF format. These drawings shall be provided in an electronic format to the company contracted to create the DVD and shall include the civil engineering, architectural, structural, electrical and mechanical sections.
   b. **Icons shall be located on the PDF plans** to link test and balance reports and mechanical operation and maintenance information to the design drawings.
   c. **All information on the DVD** shall be printable on 8.5 x 11 plain paper with the design drawings and automatic temperature control drawings printable on 11 x 17 plain paper.
   d. Linked information shall be formatted such that the user can **key word search** for information.
   e. **Provide a hyper-text alphabetical index** of all equipment and building products as outlined in item 1 above.
   f. **Use multimedia formattin**g (text, pictures, graphics and sound etc.) to make the information more accessible and understandable.
   g. Convert all documentation to an unchangeable Portable Document Format (PDF).
   h. **DVD shall start automatically** when inserted in the drive using Windows 2010 or earlier operating system. Any directions to continue will be observable on the screen.
   i. **Operation and maintenance information** to be supplied to the company contracted to do the DVD by the contractor and suppliers providing the materials and equipment.
5. **At the beginning or start-up of the DVD** there shall be a General Information Index screen to direct the user to the portion of the manual desired. This index screen will consist of four (4) major groups. The groups will include:
   a. **Contract Developers:** This section is to include:
      1) Names of architects, engineers and contractors with address and telephone numbers.
   b. **Equipment List:** This section to include:
      1) A job specific alphabetical list of all items supplied to the project with names of the manufacturer, Item description including the plan number, model number and local supplier with current address and telephone number.

c. **Design drawings, Project Manual, approved submittals**

d. **Manufacturer's Operation and Maintenance Manuals:**

1) **Architectural Section:** This section to include:

(a) Building products, applied materials and finishes: Include product data with catalog number, size, composition, color and texture designations. Provide information for reordering custom manufactured products. Data shall include, but not limited to, information on carpet, floor tile, vinyl wall finishes, builders hardware, etc.

(b) Instruction for care and maintenance to include manufacturer's recommendation for cleaning agents and methods, precaution against detrimental agents and methods and recommended schedule for cleaning and maintenance.

2) **Mechanical Section:** This section to include items in Divisions 22 and 23:

(a) A general description of the mechanical system.

(b) A step by step procedure to follow in putting each piece of mechanical equipment into operation.

(c) Schematic control diagrams for each separate fans system, heating system, control panel, etc. Each diagram shall show locations of all control and operating components and devices.

(d) Test and balance report.

(e) Valve tag schedule.

(f) All manufacturer's operation and maintenance manual information.

(g) Maintenance instructions: This portion shall include a summary list of mechanical equipment requiring lubrication showing name of equipment and type and frequency of lubrication. Special Maintenance Instructions to be summarized as follows: Preventative maintenance procedures; Seasonal start-up and shut-down maintenance; Periodicial inspection requirements; Water treatment procedures.

3) **Electrical Section:** This section to include items from Division 26:

(a) Building products, applied materials and equipment: Include product data with catalog number. Provide information for reordering custom manufactured products.

(b) Instruction for care and maintenance to include all manufacturer's recommendations.

6. **Film all training sessions** and include on DVD. Refer to Division 1 Section "Demonstration and Training" for additional information.

7. **Furnish four (4) copies** of DVD to Owner's representative.

## 1.8 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. **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 (115-by-280-mm) 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.
   3. **Identify each binder** on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

D. During warranty period, a minimum of **two (2) working days notice** shall be given the Facilities Management Business Center **prior to arrival on the job site for warranty work.** The Business Center will, in turn, notify and make arrangements with the appropriate personnel.

## 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 DEMONSTRATION AND TRAINING

A. **Instruction**: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Provide instructors experienced in operation and maintenance procedures.
   2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
   3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
   4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. **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. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
   1. System design and operational philosophy.
   2. Review of documentation.
   3. Operations.
   4. Adjustments.
   5. Troubleshooting.
   6. Maintenance.
   7. Repair.

## 3.2 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 following** 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, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. **Sweep paved areas** broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. **Rake grounds** that are neither planted nor paved to a smooth, even-textured surface.
   d. **Remove tools**, construction equipment, machinery, and surplus material from Project site.
   e. **Remove snow and ice** to provide safe access to building.
   f. **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.
   g. **Remove debris** and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. **Sweep concrete floors broom clean** in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   j. **Clean transparent materials**, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. **Remove labels** that are not permanent.
   l. **Touch up and otherwise repair and restore marred**, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) **Do not paint** over "**UL**" and similar labels, including mechanical and electrical nameplates.
   m. **Wipe surfaces** of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   n. **Replace parts** subject to unusual operating conditions.
   o. **Clean plumbing fixtures** to a sanitary condition, free of stains, including stains resulting from water exposure.
   p. **Replace disposable air filters** and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

q. **Clean ducts**, blowers, and coils if units were operated without filters during construction.

r. **Clean light fixtures**, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

s. **Leave Project clean** and ready for occupancy.

C. **Pest Control**: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. **Cleaning Standards**: 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.

## 3.3 TRANSFER OF ITEMS FROM CONTRACTOR TO UNIVERSITY

A. All items transferred directly to the Owner by the Contractor shall be accompanied by a letter of transmittal documenting the item or items. This letter shall be signed by the Owner's representative and a copy of the signed letter delivered to the Owner as a record copy. Keys, salvaged equipment, extra or service parts, attic stock or other similar type items shall be handled in this way to avoid misunderstanding of what has been transferred and when.

**END OF SECTION**

# SECTION 01 7800

# OPERATION AND MAINTENANCE DATA

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section 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. **Maintenance manuals** for the care and maintenance of products, materials, and finishes systems and equipment.
5. **Requirements and procedures** for operating the facility **after commissioning**.

B. **Related Sections** include the following:
1. **Division 1** Section "**Submittal Procedures**" for submitting copies of submittals for operation and maintenance manuals.
2. **Division 1** Section "**Closeout Procedures**" for submitting operation and maintenance manuals.
3. **Division 1** Section "**Project Record Documents**" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 2 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

### 1.3 DEFINITIONS

A. **System**: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. **Subsystem**: A portion of a system with characteristics similar to a system.

### 1.4 SUBMITTALS

A. **Initial Submittal**: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. **Final Submittal**: Submit 2 of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

## 1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## 1.6 QUALITY ASSURANCE

A. Coordinate with Commissioning Sections. The Commissioning Agent shall review the Operation and Maintenance Manuals for systems that were commissioned.

# PART 2 - PRODUCTS

## 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. **Organization**: Include a section in the directory for each of the following:
1. List of **documents**.
2. List of **systems**.
3. List of **equipment**.
4. Table of **contents**.

B. **List of Systems and Subsystems**: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. **List of Equipment**: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. **Tables of Contents**: Include a table of contents for each emergency, operation, and maintenance manual.

E. **Identification**: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## 2.2 MANUALS, GENERAL

A. **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.
3. Manual contents.

B. **Title Page**: Enclose title page in transparent plastic sleeve. 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, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. **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.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. **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.
   1. Binders: Heavy-duty, 3-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. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. 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. 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 diskettes for computerized electronic equipment.
   4. **Supplementary Text**: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
   5. **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.

E. **Maintenance Inspection Requirements**: Describe inspection schedule and procedures necessary to promote durability of materials, components, and systems. Include the following:
   1. **Exterior**: Inspection of exterior for assessment of possible water ingress. Indicate points of potential concern.
   2. Equipment: Seasonal inspection of equipment. Coordinate with Division 1 Section “Commissioning.”

F. **Environmental Requirements**:
1. Identify environmentally preferable materials and systems incorporated into the Project. Include: product model; manufacturer's name, address, phone, and website; and local technical representative, if any.
   a. Describe maintenance procedures associated with environmentally preferable materials and systems. Provide cleaning recommendations in accordance with ASTM E1971.
      1) Include potential environmental impacts of recommended maintenance procedures and materials.
      2) Include potential indoor air quality impacts of the recommended maintenance procedures and materials.

## 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:
1. System, subsystem, and equipment descriptions.
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.
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.
6. Normal shutdown instructions.
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 MANUAL

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.
4. Material and chemical composition.
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. **Attic Stock/Extra Materials:** Include within maintenance manuals a detailed list of items furnished as attic stock/extra materials, as required by individual specification sections. Indicate quantity, type, color, and other pertinent features, as well as location where stored. List shall be signed by a representative of the Owner, verifying that materials have been furnished.

G. **Warranties and Bonds**: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## 2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

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 printed 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 videotape, 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.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

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.
   1. Include procedures to follow and required notifications for warranty claims.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

A. **Operation and Maintenance Documentation Directory**: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. **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.

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

D. **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.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. **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.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. **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.

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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## SECTION 01 7900

## DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 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. **Administrative and procedural requirements** for instructing Owner's personnel on environmental issues associated with operation and maintenance of the facility.
   4. **Demonstration** and training **CD's**.

B. **Related Sections** include the following:
   1. **Division 1** Section "**Project Management and Coordination**" for requirements for preinstruction conferences.
   2. **Divisions 2 through 33** Sections for specific requirements for demonstration and training for products in those Sections.

C. **Unit Price for Instruction Time**: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

D. **DVD**: A high-density optical disk for storing large amounts of data, especially high-resolution audio-visual material

### 1.3 SUBMITTALS

A. **Instruction Program**: Submit two 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. At completion of training, submit two complete training manual(s) for Owner's use.

B. **Qualification Data**: For firms and persons specified in Quality Assurance Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners and other information specified.

C. **Attendance Record**: For each training module, submit list of participants and length of instruction time.

D. **Evaluations**: For each participant and for each training module, submit results and documentation of performance-based test.

E. **Demonstration and Training DVD's**: Submit two copies of each session, converted to a DVD within seven days of end of each training module.
   1. **Identification:** On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of photographer.
      c. Name of Architect and Construction Manager.
      d. Name of Contractor.
      e. Date videotape was recorded.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   2. **Transcript**: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding DVD. Include name of Project and date of DVD on each page.

## 1.4 QUALITY ASSURANCE

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

B. **Preinstruction Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Coordinate with commissioning requirements. Refer to Commissioning Sections.
   4. Review required content of instruction.
   5. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. 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, and as follows:
   1. Review of site specific **procedures and management** plans implemented during construction:
      a. **Indoor Air Quality** (IAQ) Management.
      b. Other topics as specified by the **Commissioning Requirements**.
   2. **Motorized doors**, including overhead coiling doors and automatic entrance doors.
   3. **Equipment,** including projection screens, loading dock equipment, food-service equipment, and residential appliances.
   4. **Fire-protection systems**, including fire alarm and fire-extinguishing systems.
   5. **Intrusion detection** systems.
   6. **Conveying systems**, including elevators and wheelchair lifts.
   7. **Heat generation**, including boilers, feedwater equipment, pumps and water distribution piping.
   8. **Refrigeration systems**, including chillers, cooling towers, condensers, pumps and distribution piping.
   9. **HVAC systems**, including air-handling equipment, air distribution systems and terminal equipment and devices.
   10. **HVAC instrumentation** and controls.
   11. **Electrical service and distribution**, including transformers, switchboards, panelboards, uninterruptible power supplies and motor controls.
   12. **Packaged engine generators**, including transfer switches.
   13. **Lighting equipment** and controls.
   14. **Communication systems**, including intercommunication, surveillance, clocks and programming, voice and data and television equipment.

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:
   1. **Basis of System Design**, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Operating standards.
      c. Regulatory requirements.
      d. Equipment function.
      e. Operating characteristics.
      f. Limiting conditions.
      g. 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 combined training manual.

B. Set up instructional equipment at instruction location.

## 3.2 INSTRUCTION

A. **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 Contractor with names and positions of participants.

B. **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, through Construction Manager, with at least 14 days' advance notice.

C. **Evaluation**: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

D. **Cleanup**: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

## 3.3 DEMONSTRATION AND TRAINING DVDS

A. **General**: Engage a qualified commercial photographer to record demonstration and training sessions. 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. **DVD Format**: Provide demonstration and training in DVD format.

C. **Recording**: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

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

E. **DVD**: Convert each recorded session to a DVD format. If multiple topics are on the same **disc it is to be indexed** to allow searching of topics.

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**SECTION 01 9113**
**GENERAL COMMISSIONING REQUIREMENTS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. OPR and BoD documentation

1.2 SUMMARY

A. Prepared by Owner and Architect contains requirements that apply to this Section.

B. This Section includes:

1. General requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
2. Commissioning Team
3. Commissioning Meetings
4. Construction Checklist Overview
5. Controls Verification
6. Functional Performance Testing
7. Training Development
8. Commissioning Plan

C. Related Sections
1. Division 1 Section “Sustainable Design Requirements” for specific requirements related to LEED Project Requirements.
2. Division 1 Section “Construction Waste Management and Disposal”
3. Division 1 Section "HVAC Systems Commissioning requirements" for specific requirements for commissioning HVAC systems.
4. Division 1 Section "Electrical Systems Commissioning Requirements" for specific requirements for commissioning Electrical Systems.

1.3 DEFINITIONS

A. BoD: Basis of Design.

B. CxA: Commissioning Authority.

C. OPR: Owner's Project Requirements.

D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

E. TAB: Testing, Adjusting, and Balancing.

## 1.4 DESCRIPTION

A. The owner has elected to use the Commissioning Process as part of their quality process to plan, design, construct and operate this building.

1. As with any quality process, Commissioning provides tools to enable everyone involved in the construction of a building to ensure that the final building meets the original intent of the Owner.
2. A primary tool used is the completion of construction checklists by individual workers. The checklists are simple to fill out and easily track the current state of work by providing the key criteria in the specifications the Owner has defined as important for the successful installation and long-term operation of systems and equipment.

B. A key component of Commissioning is the verification of the operation of systems, including electrical, plumbing, and heating and cooling systems in all modes of operation to ensure the building is ready for year-round occupancy.

C. Commissioning provides focused training of operation and maintenance personnel by ensuring that detailed training agendas are utilized and requiring detailed submittal requirements from Contractors prior to accomplishing any training.

D. The owner is financially responsible for contracting the services of the CxA to perform the CxA duties as specified in this section.

E. The contractor is responsible to deliver a quality, functionally complete system as specified in the project documents. In the event that the contractor has certified that systems are complete and functional, and then the systems fail inspection or verification, the contractor will be financially responsible for the additional services of the CxA to retest equipment.

F. Systems to be commissioned:

1. Electrical:
   a. Normal Power Systems
   b. Emergency Power
   c. Lighting Control Systems
   d. Daylight Dimming Control Systems

2. Mechanical Systems:
   a. Building HVAC System and Controls
   b. Plumbing Systems

3. Building Envelope:
   a. Curtain wall and glazing systems
   b. Roofing systems
   c. Insulation and vapor barrier systems

## 1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

2. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
1. CxA: Utah New Vision Construction LLC. is the designated company that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner has engaged the CxA under a separate contract.
2. Representatives of the Owner's facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

## 1.6 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to the following:

1. Training in operation and maintenance of systems, subsystems, and equipment.
2. On-Site Inspections
3. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the BoD documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

## 1.7 CONTRACTOR'S RESPONSIBILITIES

A. Coordinate this Article with requirements specified in Division 01 Section "Multiple Contract Summary" for Project Coordinator's responsibilities.

B. Provide utility services required for the commissioning process.

C. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.
2. Integrate all commissioning activities into the master schedule.
3. Participate in maintenance orientation and inspection.
4. Participate in operation and maintenance training sessions.
5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
7. Review and approve final commissioning documentation.
8. Participate in the Ten-Month Review as required by LEED

D. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Provide scheduling input to the Contractor.
4. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
5. Provide information to the CxA for developing construction-phase commissioning plan.
6. Participate in training sessions for Owner's operation and maintenance personnel.
7. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section "Operation and Maintenance Data."
8. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.
9. Participate in the Ten-Month Review as required by LEED

1.8 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.

C. Review and comment on submittals from Contractor for compliance with the OPR, BoD, Contract Documents, and construction-phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BoD.

D. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

E. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the OPR, BoD, and Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

F. Prepare Project-specific test and inspection procedures and checklists.

G. Develop an enhanced start-up and initial systems checkout plan with Subs.

H. Schedule, direct, witness, and document tests, inspections, and systems startup.

I. Compile test data, inspection reports, and certificates and include them in the commissioning report.

J. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 01 Section "Project Record Documents."

K. Review and comment on operation and maintenance documentation for compliance with the OPR, BoD, and Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."

L. Prepare operation and maintenance training program and provide qualified instructors to conduct operation and maintenance training. Operation and maintenance training is specified in Division 01 Section "Demonstration and Training."

M. Prepare commissioning report.

N. Prepare and submit LEED documentation

## 1.9 COMMISSIONING DOCUMENTATION

A. OPR: A written document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

B. BoD Document: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
2. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
3. Description of responsibilities of commissioning team members.
4. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
5. Communications channels that will be used during the commissioning process.
6. Identification of systems and equipment to be commissioned.

D. Test Checklists:

1. CxA, with assistance of Architect/Engineers, shall:
   a. Develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested.
   b. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
      a) Name and nomenclature of tested item.
      b) Indication of whether the record is for a first test or retest following correction of a problem or issue.
      c) Dated signatures of the person performing test and of the witness, if applicable.
      d) Individuals present for test.
      e) Deficiencies.

2. Contractor, Subcontractor(s), and Installer(s) shall,
   a. Provide on-site startup reports by factory representative where required in the specification.
   b. Provide Certificate of Readiness: Certificate of Readiness shall be signed certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

E. Test and Inspection Reports:

1. CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data.
2. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

F. Corrective Action Documents:

1. CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any.
2. Retest systems and equipment requiring corrective action and document retest results.

G. Commissioning Report:

1. CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment.
2. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD, and Contract Documents.
3. The commissioning report shall include, but is not limited to, the following:
   a. Lists and explanations of substitutions; compromises; variances in the OPR, BoD, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution.
   b. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation.
   c. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
   d. OPR and BoD documentation.
   e. Commissioning plan.
   f. Project Correspondence
   g. Completed test checklists.

H. LEED Documentation:

1. EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
   a. Completed Owner's Project Requirements (OPR) and Basis of Design (BOD) documentation.
   b. Incorporated Commissioning requirements into construction documents.
   c. Developed and utilized a commissioning plan.
   d. Verified installation and performance of commissioned systems.
   e. Completed Commissioning Report.

2. EA Credit 3: Enhanced Commissioning
   Verify the following:

a. The CxA has conducted at least one Commissioning Design Review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase and back-check the review comments following design submission.
b. The CxA has reviewed contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD.
c. A systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems has been prepared for the project.
d. The operating personnel and building occupants have been trained in the operation and maintenance of the commissioned systems.
e. The CxA will review building operation within 10 months after substantial completion, and a plan for resolution of outstanding issues has been completed.

I. Listing of off-season test(s) not performed and a schedule for their completion.

1.10 SUBMITTALS

A. Commissioning Plan Preliminary Submittal:

1. CxA shall submit three hard copies of preliminary commissioning plan. Deliver one copy to Contractor, one to Owner, and one to Architect.
2. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final construction-phase commissioning plan.

B. Commissioning Plan Final Submittal:

1. CxA shall submit two hard copies and two sets of electronically formatted information of final commissioning plan.
2. Deliver one hard copy and one set of discs to Architect. The final submittal must address previous review comments. The final submittal shall include a copy of the preliminary submittal review comments along with a response to each item.

C. Test Checklists and Report Forms:

1. CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment.
2. Submit two copies of each checklist and report form.

D. Test and Inspection Reports: CxA shall submit test and inspection reports.

E. Commissioning Report Submittal:

1. CxA shall submit two hard copies and two sets of electronically formatted information of the final commissioning report.
2. CxA shall deliver one hard copy and one set of discs to Architect.

F. LEED Documentation Submittal:

1. Upload the required LEED documentation to the U.S. Green Building Council (USGBC) web site.

1.11 COORDINATION

A. Testing Coordination: CxA shall coordinate sequence of testing 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 and schedule times for tests, inspections, obtaining samples, and similar activities.

B. Manufacturers' Field Services: Contractor shall coordinate services of manufacturers' field services personnel.

## PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard Testing Equipment: All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipments for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the Division Contractor as needed and as directed by the CxA.

B. Special Equipment: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CA.

C. Data Logging Equipment: Data Logging equipment, software and services required to test equipment will be provided by the contractor, but shall not become the property of the Owner.

D. Equipment Quality: All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer’s recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

## PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference:

1. Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors.

B. Training Modules:

1. An instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section "Demonstration and Training" will be developed
2. Each module shall be developed according to the format established for this project, by the individuals responsible for that system or component.

3.2 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Contractor. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made by the contractor.

**END OF SECTION 01 9113**

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# SECTION 01 9119

# BUILDING ENCLOSURE FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. The work under this section is subject to requirements of the Contract Documents, including the Owner's General Conditions and articles of the General Contractor's General Conditions.

B. This section includes the functional performance testing requirements for the Building Enclosure systems. Refer to Section 019126 for Building Envelope Commissioning Requirements

### 1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section. Division 4, 7 and 8 Specification Sections also apply to this section. Where conflicts arise regarding building envelope testing, this Section shall supersede other Sections where contradictions occur.

### 1.3 TESTING AGENCY

A. The BETA is the same entity as the BECA.

### 1.4 ABBREVIATIONS

A. The following are common abbreviations used in the Specifications (definitions are found further in this Section):

1. A/E - Architect and Design Engineers
2. BECA – Building Enclosure Commissioning Agent
3. CxA - Commissioning Agent - Refer to Section 019113
4. GC - General Contractor
5. CT - Commissioning Team
6. Cx - Commissioning
7. Cx Plan - Commissioning Plan
8. FPT - Functional Performance Test
9. OR - Owner's Representative
10. O&M - Operations & Maintenance
11. RFI - Request for Information
12. BETA – Building Enclosure Testing Agency

### 1.5 DEFINITIONS

A. See building Enclosure Commissioning Requirements section 019216 for definitions.

## 1.6 RELATED WORK

A. Specific building enclosure commissioning requirements are given in this specification. The following specification sections are related to the commissioning work specified in this section:

1. General Commissioning Requirements
2. Building Envelope Commissioning Requirements: Refer to 019216
3. Basic Masonry Requirements: Refer to Division 04
4. Basic Waterproofing, Roofing, Air Barrier and Insulation Requirements: Refer to Division 07
5. Basic Fenestrations Requirements: Refer to Division 08

## 1.7 COORDINATION

A. **Functional Performance Team Members will consist of:**

1. Commissioning Agent (CxA)
2. Building Envelope Commissioning Agent (BECA)
3. Building Envelope Testing Agent (BETA)
4. Owner's Representative(s) (OR)
5. General Contractor (GC)
6. Architect and Design Engineers (A/E)
7. Building Envelope Sub-contractors

B. **Management:** The BETA is the same entity as the BECA.

C. **Scheduling**:

1. BECA/BETA will work with the GC to establish a functional performance testing schedule.

## 1.8 REPORTING

A. BECA/BETA shall submit all test reports to the GC, CxA, A/E and Owner as needed.

B. BECA shall submit non-compliance and deficiency reports to GC, CxA, A/E and Owner as needed.

## 1.9 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. **Documentation**

1. BECA/BETA will witness/perform and document results of FPT.

B. **Non-Conformance**

1. BECA/BETA will record results of functional testing. Deficiency or non-conformance issues will be noted and reported to GC, CxA and Owner.

2. Corrections of minor deficiencies identified may be made during tests at discretion of BECA. In such cases, deficiency and resolution will be documented.

3. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. BECA shall not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.

4. Deficiencies are handled in the following manner:

   a. When there is no dispute on deficiency and Sub-contractor accepts responsibility for remedial action:

      1) BECA documents deficiency and Sub-contractors response and intentions and they go on to another test or installation. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC. Sub-contractor corrects deficiency and certifies that material or assembly is ready to be retested. GC informs CT of retesting schedule.

      2) GC reschedules test with BECA/ BETA.

   b. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

      1) BECA documents deficiency and Contractor's response. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC.

      2) GC facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority is with A/E. Final acceptance authority is with the Owner.

      3) GC documents resolution process.

      4) Once interpretation and resolution has been decided, appropriate party corrects deficiency, GC reschedules test, and test is repeated until satisfactory performance is achieved.

C. **Cost of Testing**

1. Costs for the initial testing located within this specification sections shall be the responsibility of the owner. The contractor is to provide access to the test specimens to the CT.

D. **Cost of Retesting**

1. Costs for all retesting will be the full responsibility of the GC and Sub-contractors. These costs include all access, equipment, labor, and materials required to complete the retesting.

## 1.10 PERFORMANCE REQUIREMENTS

A. The performance criteria below apply to all mock-up and field testing of exterior envelope components.

B. Air and water performance criteria summary table according to each component:

| Component | Performance Criteria | |
|---|---|---|
| | **Air** | **Water** |
| Curtain Wall/ Fenestrations | ASTM E 1186 (4.2.7) – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s) | AAMA 501.1/ ASTM E 1105 - No uncontrolled water leakage when tested under a pressure difference of 8.0 lbf/sq. ft (curtain wall) and 6.24 lbf/sq. ft. (storefront) |
| | ASTM E 783 – Maximum air leakage of 0.09 cfm/ft at an air pressure differential of 6.24 psf (curtain wall) and maximum air leakage of 0.09 cfm/ft at an air pressure differential of 1.57 psf (storefront) | |
| Air Barrier Assemblies | ASTM E 1186 (4.2.6) – Pass/fail criteria shall be no bubbles observed in the leak detection liquid. | AAMA 501.1/ ASTM E 1105 - No uncontrolled water leakage when tested under a pressure difference of 8.0 lbf/sq. ft |
| | ASTM E 783 – Maximum air leakage of 0.04 cfm/ft at an air pressure differential of 1.57 psf | |
| | ASTM E 1186 (4.2.7) – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s) | |
| Roofing Systems | ASTM E 1186 (4.2.6) – Pass/fail criteria shall be no bubbles observed in the leak detection liquid. | |

C. Water leakage is only acceptable if ALL of the following conditions are satisfied:

1. Water is contained and drained to the exterior.
2. There is no wetting of a surface that is visible to the building occupants.
3. There would be no staining or other damage to the completed building or finishes.

D. Where testing indicates that performance requirements are not met, the contractor shall repair or replace the failed section and a re-test conducted. Any repairs should be conducted with inspection by the BECA. Retesting shall be conducted by the BECA/BETA. All costs associated with the repair and re-testing shall be the responsibility of the contractor.

E. In addition to retesting, failed tests will typically result in testing of an additional specimen at the discretion of the owner and at the cost of the contractor. Testing will be concluded only when satisfactory results are achieved.

## 1.11 MOCK-UP TEST REQUIREMENTS

A. A building envelope mock-up shall be constructed and tested prior to commencement of installation of building envelope components responsible for providing environmental separation. Testing will be conducted on the installed fenestration, air barrier, and any terminations or penetrations through the air barrier such as fasteners but prior to the installation of any exterior claddings. Interior finishes, interior gypsum wall board, or insulation should not be installed prior to mock-up testing. The mock-up shall include a junction with the roofing membrane, a building corner condition, and foundation wall intersection. The mock-up shall employ no less than 100 sq. ft. of opaque wall and a fenestration assembly. The mock-up shall include at least a portion of the terra cotta cladding, architectural concrete exterior wall, and curtain wall and storefront systems. For certain building components that are not included in the free standing mock-up, separate mini mock-ups that are the first installed on the building to remain are acceptable.

B. The coordination, construction and completion of the mock-up construction are the responsibility of the General Contractor. It is the responsibility of the General Contractor to construct and repair the test chamber/enclosure as necessary to create an air-tight chamber. Mock-up test chambers/enclosures are typically constructed of wood or steel framing, exterior sheathing, and a sheet applied air barrier. Prior to testing, the BETA will pressurize the test chamber while simultaneously supplying smoke to the chamber. Any voids in the chamber air barrier will be identified and sealed to create an air-tight chamber. The General Contractor shall permit inspections of the mock-up to the BECA and BETA and any member of the building envelope commissioning team throughout construction and testing as required.

C. It is left to the discretion of the OR and/or A/E to have all exterior insulation, claddings, etc. installed after the completion of mock-up performance testing.

D. The following test protocol shall be completed after installation of air barriers including all flashings, fenestration assemblies, and all penetrations through the air barrier, but prior to installation of exterior cladding and interior finishes.

1. ASTM E 1186-03 method 4.2.7, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems; Use pressurization and smoke tracers to identify leak locations through the mock-up chamber and the face of the mock-up. All leaks through the mock-up chamber must be sealed prior to commencing ASTM E 283 testing.

2. ASTM E 1186-03 method 4.2.6, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems; Use chamber depressurization and site detection liquid at penetrations through the air barrier (e.g. fastener penetrations). Pass/fail criteria shall be no bubbles observed in the leak detection liquid. A minimum of 5 locations at each type of fastener (fasteners at masonry anchors, girts, or other cladding receptors) shall be tested. Testing may require special installation of any continuous girts or cladding receptors such that dome can be placed completely around girt or receptor (Dome has diameter or approximately 18 in.) This is typically accomplished by installing and fastening a 12 in. portion of the girt or receptor (may not be required dependent on cladding type).

3. ASTM E 283-04, Standard Test Method for Determining the rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

4. ASTM E 331-00, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

   a. In the event of water leakage through the test, additional isolation testing shall be conducted to best determine the location of the water infiltration as required.

5. AAMA 501.1, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors using Dynamic Pressure;

   a. In the event of water leakage through the test, additional isolation testing shall be conducted to best determine the location of the water infiltration as required.

6. ASTM D 4541-09, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; Measured air barrier adhesion strength shall not be less than 16 lbf/sq. inch. (Test only conducted after all other tests listed above have been successfully performed since test method is destructive).

E. Where testing indicates that performance requirements are not met, the contractor shall repair or replace the failed section and a re-test conducted. Any repairs should be conducted with inspection and documentation by the BECA. Retesting shall be conducted by the BETA. All costs associated with the repair, retesting and re-inspection shall be the responsibility of the contractor.

## 1.12 FIELD TEST REQUIREMENTS

A. All functional performance tests shall be conducted in conformance with project performance requirements as set forth below:

B. The following test methods shall be performed during the construction phase:

1. ASTM E 1186-03, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, Method 4.2.7. Testing performed at four (4) locations at the exterior building enclosure at locations deemed critical by the CT.

2. AAMA 501.1, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors using Dynamic Pressure. Testing performed at six (6) locations at the exterior building enclosure at locations deemed critical by the CT.

## PART 2 – PRODUCTS (Not Used)

## PART 3 – EXECUTION (Not Used)

**END OF SECTION**

# SECTION 01 9126

# BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES:

A. The work under this section is subject to requirements of the Contract Documents, including the Owner's General Conditions and articles of the General Contractor's General Conditions.

B. This section includes the commissioning requirements for the Building Enclosure systems. Refer to Section 019119 for Building Enclosure Functional Performance Testing.

1. The commissioning requirements for the Building Enclosure systems given in this section are entirely separate from, and in addition to, the General Commissioning Requirements for this project. The General Contractor (GC), Contractors, Subcontractors, and Suppliers are required to participate in both commissioning processes as required any supplemental General Commissioning requirements.

2. The Commissioning Agent and Building Enclosure Commissioning Agent will provide separate documentation for each commissioning process.

### 1.2 DESCRIPTION

A. Building Enclosure Commissioning (BECx) is a systematic process of ensuring all building enclosure systems responsible for environment separation perform interactively according to the Owner's Project Requirements and the Architect's Basis of Design. The BECx process is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify and document proper installation and performance of building enclosure materials and systems.

2. Provide Owner with functional building enclosure systems with minimal performance problems at project completion.

B. Commissioning does not take away from, or reduce responsibility of, system designers or installing contractors to provide a finished and fully functioning product.

C. This section shall in no way diminish the responsibility of Division 03, 04, 07, 08, and 09 Contractors, Subcontractors, and Suppliers in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this section are in addition to requirements outlined in Division 03, 04, 07, 08, and 09.

### 1.3 ABBREVIATIONS

A. The following are common abbreviations used in the Specifications (definitions are found further in this Section):

1. A/E - Architect and Design Engineers
2. BECA – Building Enclosure Commissioning Agent
3. CxA - Commissioning Agent - Refer to Section 019113
4. GC - General Contractor
5. CT - Commissioning Team

6. Cx - Commissioning
7. Cx Plan - Commissioning Plan
8. FPT - Functional Performance Test
9. OR - Owner's Representative
10. O&M - Operations & Maintenance
11. RFI - Request for Information

## 1.4 DEFINITIONS

A. **Approval:** Acceptance that a material or system has been properly installed and is functioning in tested modes according to the Contract Documents.

B. **Architect/Engineer (A/E):** Prime consultant (architect) and sub-consultants who comprise the design team, generally the Architect of Record and any Design Sub-consultants.

C. **Basis of Design (BOD):** Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to meet intent.

D. **Building Enclosure Commissioning Agent (BECA):** Contracted to Owner through the CxA. BECA directs and coordinates day-to-day building enclosure commissioning activities independently from CxA.

E. **Commissioning Agent (CxA):** Contracted to Owner. CxA directs and coordinates day-to-day commissioning activities excluding BECx activities. CxA reports directly to Owner.

F. **Commissioning Plan:** Overall plan developed after bidding that provides structure, schedule, and coordination planning for commissioning process. A specific building enclosure section will be added into the project's commissioning plan.

G. **Contract Documents:** Documents binding on parties involved in construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).

H. **Deficiency:** Condition of a building enclosure material or system that is not in compliance with Contract Documents (that is, does not perform properly or is not complying with design intent).

I. **Functional Performance Test (FPT):** Test of performance of building enclosure materials and systems. Systems are tested under various simulated environmental conditions, such as air leakage under pressure differential and water leakage under pressure differential with water spray.

J. **Owner's Project Requirements (OPR):** A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

K. **Simulated Condition:** Condition created for testing component or system (e.g., applying pressure differential across the building enclosure concurrent with water spray to simulate a wind driven rain).

L. **Specifications:** Construction specifications of Contract Documents.

M. **Mock--up:** The activities where systems or materials are initially constructed and tested. Mock-ups are to be free standing and approved prior to commencing full scale construction.

N. **Sub-contractor:** Contractors of GC, and their Sub-contractors, who provide and install building enclosure components and systems.

## 1.5 RELATED WORK

A. Specific building enclosure commissioning requirements are given in this specification. The following specification sections are related to the commissioning work specified in this section:

1. General Commissioning Requirements: Refer to 019113
2. Building Enclosure Functional Performance Testing: Refer to 019119
3. Basic Concrete Requirements: Refer to Division 03
4. Basic Masonry Requirements: Refer to Division 04
5. Basic Waterproofing, Roofing, Air Barrier and Insulation Requirements: Refer to Division 07
6. Basic Fenestrations Requirements: Refer to Division 08
7. Basic Finishing Requirements: Refer to Division 09

## 1.6 COORDINATION

A. **Commissioning Team:** Members of the Commissioning Team (CT) will consist of:

1. Commissioning Agent (CxA)
2. Building Enclosure Commissioning Agent (BECA)
3. Building Enclosure Testing Agent (BETA)
4. Owner's Representative(s) (OR)
5. General Contractor (GC)
6. Architect and Design Engineers (A/E)
7. Building Enclosure Subcontractors

B. **Management:** Owner will contract services of the BECA directly. The BECA will direct and coordinate commissioning activities and report to the OR. All members of the Commissioning Team shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.

**C. Scheduling:**

1. BECA will work with commissioning team to establish required commissioning activities to incorporate in preliminary commissioning schedule. The GC will integrate commissioning activities into master construction schedule. Necessary notifications are to be made in a timely manner in order to expedite commissioning.

## 1.7 SUBMITTALS

A. A/E or General Contractor shall provide BECA with documentation required for commissioning work. At minimum, documentation shall include: General Commissioning Requirements and performance data and any performance test procedures. In addition, installation and checkout materials shall be submitted to BECA.

B. BECA shall review submittals concurrent with the A/E for conformance as it relates to commissioning.

## PART 2 – PRODUCTS (Not Used)

## PART 3 – EXECUTION

### 3.1 SYSTEMS TO BE COMMISSIONED

A. **Building Enclosure**

1. Below Grade Systems, Roofing Systems, Opaque Wall/Cladding Systems, Fenestration Systems responsible for providing the following functions:

    a. Air barrier
    b. Vapor barrier
    c. Insulation
    d. Waterproofing

### 3.2 RESPONSIBILITIES OF COMMISSIONING TEAM MEMBERS DURING CONSTRUCTION PHASE

A. **Architect/Engineer (A/E)**

1. Document design intent of systems.
2. Review and incorporate building enclosure commissioning specification and functional performance test specification into the construction documents.
3. Provide construction documents electronically.
4. Review BECA comments on construction document and shop drawings.
5. Assist in dispute resolution regarding building enclosure items.
6. Review BECA reports.

B. **Building Enclosure Commissioning Agent (BECA)**

1. Participate in an initial team conference call to identify the OPR
2. Develop BECx plan
3. Develop BECx Requirements specification
4. Develop Building Envelope Functional Performance Test specification
5. Review architectural drawings and specifications pertinent to the building envelope
6. Review shop drawings and submittals prior to or concurrent with the A/E reviews
7. Observe the construction of the mock-up and perform testing on the mock-up
8. Attend the construction BECx kick-off meeting
9. Finalize the commissioning plan
10. Field monitor installation of exterior envelope components against construction documents and manufacturer's instructions. Includes site visits to observe the testing of building enclosure components and assemblies.
11. Building envelope mock-up and field testing
12. Finalize commissioning records and close-out documents

C. **General Contractor (GC)**

1. Attend commissioning kick-off meeting and other commissioning team meetings.
2. Incorporate commissioning activities into the construction schedule.
3. Periodically update commissioning activities in the construction schedule.
4. Facilitate cooperation of Sub-contractors in commissioning work.
5. Submit copies of initial and final A/E approved submittals for commissioned system equipment to BECA for review.
6. Review BECA submittal comments
7. Verify building enclosure materials and assemblies are ready for functional testing.
8. Submit maintenance logs of all interim maintenance or repair tasks performed by Sub-contractors.
9. Insure resolution of non-compliance and deficiencies in construction or test results. Obtain written documentation of completion from the appropriate Sub-contractors.

10. Provide letters of compatibility for adjacent building enclosure materials and assemblies.
11. Facilitate all repairs and retesting of failed condition and pay for all associated costs.
12. Provide all warrantee information to BECA

D. **Subcontractors/Vendors**

1. Review Commissioning Plan and FPT specification.
2. Attend commissioning kick-off meeting and other commissioning team meetings.
3. Notify GC and BECA of work completion.
4. Attend all required material and systems testing.
5. Execute all periodic maintenance or repairs required on started systems from initial mock-up of equipment to final acceptance by Owner to prevent material warranties from being voided.
6. Ensure installation work is complete, is in compliance with Contract Documents, and is ready for Functional Performance Testing. Notify GC that equipment and systems are ready for Functional Performance Testing. FPT test results will be documented by BECA
7. Provide all warrantee information to GC.

E. **Building Enclosure Testing Agency (BETA)**

1. Attend commissioning kick-off meeting and other commissioning team meetings.
2. Provide on-site technician and equipment to complete mock-up and field Functional Performance Testing.
3. Prepare and submit reports at the conclusion of all testing.
4. Perform retesting and prepare corresponding reports.

## 3.3 BUILDING ENVELOP COMMISSIONING TEAM (BECx) MEETINGS

A. BECx meetings will be held periodically as determined by the BECA.

B. Discussions held in BECx meetings shall include, but not be limited to, system/materials, mock-up/field, progress, scheduling, testing, documentation, deficiencies, and problem resolution.

## 3.4 REPORTING

A. BECA will provide status reports to GC, CxA, A/E, and Owner as needed.

B. BECA shall submit non-compliance and deficiency reports to GC, CxA, A/E, and Owner as needed.

C. BECA shall provide a final summary report to CxA and Owner.

## 3.5 MOCK-UP AND FINAL CONSTRUCTION

A. GC and Subcontractors shall verify completion of assemblies compliant with project documents and deficiency log items prior to functional performance testing or concealment of functional performance layers within the building enclosure.

## 3.6 FUNCTIONAL PERFORMANCE TESTING

A. **Objectives and Scope**

1. The objective of Functional Performance Testing is to demonstrate each system is operating according to documented design intent and Contract Documents. Functional Performance Testing facilitates bringing systems from a state of substantial completion to fully operational. Additionally, during Functional Performance Testing, areas of deficient performance are identified and corrected, improving operation and functioning of systems.

B. **Development of Test Procedures**

1. The purpose of a specific test is to verify and document compliance of the installed enclosure systems with the OPR. The BECA shall develop specific test procedures for inclusion in Specification Section 019119 – Building Enclosure Functional Performance Testing

C. **Coordination and Scheduling**

1. GC will provide sufficient notice to BECA regarding completion schedule for materials and systems. GC will schedule Functional Performance Tests with CT. BECA shall witness and document functional testing of equipment and systems. BETA shall execute tests under direction of BECA. BETA may be the same entity as the BECA if deemed the best value to the project.

2. Successful completion of mock-up functional performance testing shall occur prior to full production installation of building enclosure materials and systems.

## 3.7 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. **Documentation**

1. BECA will witness and document results of FPT.

B. **Non-Conformance**

1. BECA will record results of functional testing. Deficiency or non-conformance issues will be noted and reported to GC, CxA and Owner.

2. Corrections of minor deficiencies identified may be made during tests at discretion of BECA. In such cases, deficiency and resolution will be documented.

3. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. BECA shall not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.

4. Deficiencies are handled in the following manner:

   a. When there is no dispute on deficiency and Sub-contractor accepts responsibility for remedial action:

      1) BECA documents deficiency and Sub-contractors response and intentions and they go on to another test or installation. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC. Sub-contractor corrects deficiency and certifies that material or assembly is ready to be retested. GC informs CT of retesting schedule.

      2) GC reschedules test with BECA and BETA.

   b. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

      1) BECA documents deficiency and Contractor's response. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC.

      2) GC facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority is with A/E. Final acceptance authority is with the Owner.

      3) GC documents resolution process.

4) Once interpretation and resolution has been decided, appropriate party corrects deficiency, GC reschedules test, and test is repeated until satisfactory performance is achieved.

**C. Cost of Retesting**

1. Costs for all retesting will be the full responsibility of the GC and Subcontractors. These costs include all access, equipment, labor, and materials required to complete the retesting.

## 3.8 COMMISSIONING DOCUMENTATION

A. **Final Report Details**

1. Final commissioning report will include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, and general description of testing and verification methods. Report will contain evaluation regarding:

   a. Conformance to specifications and design intent
   b. Material/system installation
   c. Functional performance

2. All outstanding non-compliance items will be specifically listed.

3. Recommendations for improvement to system or operations, future actions, etc. will also be listed.

**END OF SECTION**

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# DIVISION 2 – EXISTING CONDITIONS


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|---|---|
| Section 02 4101 | Cutting and Patching |
| Section 02 4102 | Selective Demolition |

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# SECTION 02 4101

# CUTTING AND PATCHING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

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

B. The General Contractor is responsible to patch and repair any and all material disturbed during construction, this is to include but not limited to walls, floors, ceilings, asphalt, concrete, lawns and landscaping, roofs, etc.

### 1.3 DEFINITION

A. **Cutting**: Removal of existing construction necessary to permit installation or performance of other Work.

B. **Patching**: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

### 1.4 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.
   1. **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.

### 1.5 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.

B. **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, including but not limited to the following:
   1. Primary operational systems and equipment.
   2. Fire-protection systems.
   3. Communication systems.
   4. Electrical wiring systems.

C. **Miscellaneous Elements**: Do not cut and patch the following 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.
   1. Piping, ductwork, vessels, and equipment.

D. **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. If possible, retain original Installer or fabricator to cut and patch exposed Work. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

E. **Cutting and Patching Conference**: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.6 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 of these Specifications.

B. **Existing Materials:** Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing 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 existing 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 existing 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 existing 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 Services**: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services 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 existing 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 existing 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. **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. **Existing Finished Surfaces**: Cut or drill from the exposed or finished side into concealed surfaces.
   3. **Concrete/Masonry**: 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 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. **Patching**: 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. Patch masonry with masonry units and grout that match as closely as possible the original. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. **Restore landscaping and irrigation system** to "like-new" condition where disturbed by new construction. Preserve and reuse existing plantings; new plantings, where required, shall match existing in size and quality; stake and secure as appropriate. Install new sprinkler heads where needed to provide full coverage of planting area – match University standards. Establish new grass with sod of blended Kentucky Bluegrass and perennial ryegrass as approved by the University. Landscape boulders shall be native stone from Owner's on-site source, final selection and placement as determined by Architect.
2. **Inspection**: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
3. **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.

**END OF SECTION**

# SECTION 02 4102

# SELECTIVE DEMOLITION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
1. **Demolition** and **removal** of selected **portions of a building** or structure.
2. **Demolition** and **removal** of selected **site elements**.
3. **Repair procedures** for selective demolition operations.

B. **Related Sections** include the following:
1. **Division 2** Section "**Cutting and Patching**" for cutting and patching procedures for selective demolition operations.
2. **Division 31** Section "**Site Clearing**" for site clearing and removal of above- and below-grade improvements.
3. **Mechanical Sections** for demolishing, cutting, patching, or relocating mechanical items.
4. **Electrical Sections** for demolishing, cutting, patching, or relocating electrical items.

### 1.3 DEFINITIONS

A. **Deconstruction**: Disassembly of buildings for the purpose of recovering materials

B. **Demolish**: Completely remove and legally dispose of off-site.

C. **Existing to Remain or Retain**: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled

D. **Protect**: Except as otherwise defined in greater detail, the term “protect” is used to describe the process of shielding from harm existing fixtures, elements or materials.

E. **Protect and Maintain**: To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.

F. **Recycle**: Recovery of demolition waste for subsequent processing in preparation for reuse.

G. **Remove**: To detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

H. **Remove and Salvage**: To detach items from existing construction and deliver them to Owner ready for reuse.

I. **Remove and Reinstall**: To detach items from existing construction, repair and clean them for reuse, and reinstall them where indicated.

J. **Salvage**: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

K. **Stabilize**: To apply measures designed to reestablish a weather-resistant enclosure and the structural reinforcement of an item or portion of the building while maintaining the essential form as it exists at present.

## 1.4 MATERIALS OWNERSHIP

A. **Historic items, relics, and similar objects** including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
   1. Coordinate with Owner who will establish special procedures for removal and salvage.

## 1.5 SUBMITTALS

A. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. **Proposed Dust-Control and Noise-Control Measures**: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. **Schedule of items and materials to be salvaged**: Identify procedures for disassembly.
   1. Coordinate with Solid Waste Management Plan. Identify materials to be recycled. Identify materials to be salvaged for reuse on site and off site.

D. **Schedule of Selective Demolition Activities**: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Locations of temporary partitions and means of egress.
   5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. **Inventory**: After selective demolition is complete, submit a list of items that have been removed and salvaged.

F. **Pre-demolition Photographs or Videotape**: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

G. **Landfill Records**: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## 1.6 QUALITY ASSURANCE

A. **Demolition Firm Qualifications**: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. **Regulatory Requirements**: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. **Standards**: Comply with ANSI A10.6 and NFPA 241.

D. **Pre-demolition Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

## 1.7 PROJECT CONDITIONS

A. **Owner will occupy portions of building** immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. **Maintain access to existing walkways**, corridors, and other adjacent occupied or used facilities.
   1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. **Owner assumes no responsibility for condition of areas** to be selectively demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. **Hazardous Materials**: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. **Storage or sale of removed items** or materials on-site will not be permitted.

F. **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.

## 1.8 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

## 2.1 REPAIR MATERIALS

A. **Use repair materials** identical to existing materials.
   1. **If identical materials are unavailable** or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. **Use materials whose installed performance equals** or surpasses that of existing materials.

B. **Comply with material and installation requirements** specified in individual Specification Sections.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Verify** that utilities 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. **Engage a professional engineer** to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. **Perform surveys** as the Work progresses to detect hazards resulting from selective demolition activities.

## 3.2 UTILITY SERVICES

A. **Existing Utilities**: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. **Utility Interruption**: Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

C. **Provide at least 72 hours'** notice to Owner if shutdown of service is required during changeover.

D. **Utility Requirements**: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

E. **Owner will arrange to shut off indicated utilities** when requested by Contractor.

F. **If utility services are required to be removed**, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

G. **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.

H. **Utility Requirements**: Refer to Mechanical and Electrical Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

## 3.3 PREPARATION

A. **Dangerous Materials**: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. **Pest Control**: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

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

1. **Do not close or obstruct streets**, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. **Erect temporary protection**, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. **Protect existing site improvements**, appurtenances, and landscaping to remain.
4. **Erect a plainly visible fence** around drip line of individual trees or around perimeter drip line of groups of trees to remain.

D. **Temporary Facilities**: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. **Provide protection** to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. **Provide temporary weather protection**, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. **Protect walls**, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. **Cover and protect furniture**, furnishings, and equipment that have not been removed.

E. **Temporary Enclosures**: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. **Where heating or cooling is needed** and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

F. **Temporary Partitions**: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

G. **Temporary Shoring**: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

H. **Pre-Demolition Meeting (Existing Arena Roof)**: Prior to beginning any structural demolition on the existing arena roof, the Contractor shall schedule and host on-site a pre-construction/pre-design meeting to discuss the extent of the roof bracing required in the Structural Drawings as it pertains to the Contractor's schedule and sequencing.

## 3.4 POLLUTION CONTROLS

A. **Temporary ventilation**: Provide temporary ventilation as specified in Section 01 5721 - Indoor Air Quality (IAQ) Management, and as follows:
   1. Vacuum old carpets prior to removal using a certified Carpet and Rug Institute (CRI) Green Label vacuum cleaner. Vacuum floor immediately after old carpet is removed.

B. **Dust Control**: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
   1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
   2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

C. **Disposal**: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

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

## 3.5 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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   5. Maintain adequate ventilation when using cutting torches.
   6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   9. Dispose of demolished items and materials promptly.
   10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. **Existing Facilities**: Comply with Owner’s requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. **Removed and Salvaged Items**: Comply with the following:
   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.

D. **Removed and Reinstalled Items**: Comply with the following:
   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.

E. **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.

F. **Concrete**: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

G. **Masonry**: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
   1. Brick to be reused shall be removed without chipping or other damage and neatly cleaned of mortar. Stack salvaged brick on pallets with mix of colors comparable to original installation.

H. **Concrete Slabs-on-Grade**: Saw-cut perimeter of area to be demolished, then break up and remove.

I. **Resilient Floor Coverings**: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

J. **Remove residual adhesive** and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

K. **Roofing**: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.

L. **Air-Conditioning Equipment**: Remove equipment without releasing refrigerants.

M. **Existing Control Devices and Systems:** Take special care to protect existing control devices, pneumatic piping, wiring etc. during demolition and construction to keep the existing building controls fully functional. Any damage incurred will be the responsibility of the Contractor to restore to a fully working condition satisfactory to the Owner.

## 3.6 PATCHING AND REPAIRS

A. **General**: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. **Repairs**: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. **Finishes**: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

D. **Floors and Walls**: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

E. **Ceilings**: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

## 3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. **General**: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. **Burning**: Do not burn demolished materials.

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

## 3.8 CLEANING

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

## 3.9 SELECTIVE DEMOLITION SCHEDULE

A. Coordinate with Architect’s plans.

B. Maintain roads shown to remain in operable condition at all times except as approved by Owner.

**END OF SECTION**

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# DIVISION 3 - CONCRETE


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| Section 03 3000 | Cast-in-Place Concrete |
| Section 03 3300 | Cast-in-Place Architectural Concrete |
| Section 03 4500 | Pre-Cast Architectural Concrete |

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## SECTION 03 3000

## CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

### 1.1 SUMMARY

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. **Section includes** cast-in-place concrete, formwork, reinforcement, and accessories.
   1. **Cast-in-place** concrete used structurally including but not limited to:
      a. Slabs on grade.
      b. Walls.
      c. Retaining walls both inside the building and site retaining walls.
      d. Suspended slabs.
   2. **Formwork**.
   3. **Reinforcement**.
      a. **Reinforcing** Bars.
      b. **Steel** Wire.
      c. **Welded Wire** Fabric.
   4. **Accessories**:
      a. Under slab **vapor barrier**.

C. Refer to **Part 3.3.C** of this Section for specified concrete finishes. **No grout cleaned or plastered finishes shall be permitted or accepted.**

D. **Related Sections** include the following:
   1. **Division 32** Section "**Cement Concrete Pavement**" for site concrete work.

### 1.2 SUBMITTALS

A. **Product Data**: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.

B. **Shop Drawings; Reinforcement**: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. **Architect's review** is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

D. **Samples**: Submit samples of materials as requested by Architect, including names, sources, and descriptions.

E. **Laboratory Test Reports**: Submit laboratory test reports for concrete materials and mix design test.

F. **Welding Certificates**: Copies of certificates for welding procedures and personnel.

G. **Materials Certificates**: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
   1. Cementitious materials and aggregates.
   2. Form materials and form-release agents.
   3. Steel reinforcement and reinforcement accessories.
   4. Fiber reinforcement
   5. Admixtures.
   6. Curing materials.
   7. Bonding agents.
   8. Adhesives.
   9. Joint-filler strips.
   10. Repair materials

## 1.3 QUALITY ASSURANCE

A. **Codes and Standards**: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   1. ACI 117 "Specifications for Tolerances for Concrete Construction and Materials".
   2. ACI 301 "Specifications for Structural Concrete for Buildings".
   3. ACI 318 "Building Code Requirements for Reinforced Concrete".
   4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. **Manufacturer Qualifications**: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
   1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's "Certification of Ready Mixed Concrete Production Facilities."

C. **Testing Agency**: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in Part 3 of this section. Owner's Project Manager will furnish contact information for testing agency to Contractor. Retesting of materials failing to meet specified requirements shall be done at Contractor’s expense.
   1. Notify Owner's testing agency 24 hours in advance.

D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer, unless otherwise approved by Owner's Project Manager.

## 1.4 PROJECT CONDITIONS

A. **Protection of Footings against Freezing**: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. **Surface Protection**: Protect adjacent finish materials against spatter during concrete placement.

## 1.5 CASH ALLOWANCE

A. Contractor shall include a **cash allowance** of **$7,500.00** for concrete reinforcing steel, be-yond that which is required by the contract documents.

B. Contractor shall include a **cash allowance** of **$5,000.00** for concrete beyond that which is required by the contract documents.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Products**: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

B. **Air Entraining Admixture**:
1. "**Air-Mix**"; Euclid Chemical Co.
2. "**MB-VR** or **MB-AE**"; Master Builders.
3. "**Darex AEA**" or "**Daravair**"; W.R. Grace.

C. **Water Reducing Admixture**:
1. "**WRDA Hycol**"; W.R. Grace.
2. "**Eucon WR-75**"; Euclid Chemical Co.
3. "**Pozzolith Normal**"; Master Builders.
4. "**Plastocrete 160**"; Sika Chemical Corp.

D. **Super Plasticizer**:
1. "**WRDA 19**" or "**Daracem**"; W.R. Grace.
2. "**Sikament**"; Sika Chemical Corp.
3. "**Eucon 37**"; Euclid Chemical Co.
4. "**Rheobuild**"; Master Builders.

E. **Water Reducing Non Chloride Accelerator**:
1. "**Accelguard 80**"; Euclid Chemical Co.
2. "**Pozzolith High Early**"; Master Builders.

F. **Water Reducing Non Chloride Retarder**:
1. "**Edoco 20006**"; Edoco Technical Products.
2. "**Pozzolith Retarder**"; Master Builders.
3. "**Eucon Retarder 75**"; Euclid Chemical Co.
4. "**Daratard**"; W.R. Grace.

G. **Non-Metallic Grout**:
1. "**Set Grout**"; Master Builders.
2. "**Duragrout**"; L & M Const. Chemical Co.
3. "**Five Star Grout**"; U.S. Grout Corp.
4. "**Non Shrink GP Grout**" US Spec.

H. **Liquid Curing Compound**:
1. **Interior**:
   a. **"L & M Cure R**" or "**L & M Cure DR**"; L & M Construction Chemicals, Inc.
   b. "**Kurez VOX**" or "**Kurez DR**"; The Euclid Chemical Co.
   c. "**1100 Clear**" or "**3100 Clear**"; W. R. Meadows.
   d. "**Maxcure Resin**" clear, US Spec.
2. **Exterior**:
   a. "**L & M Cure R-2**"; L & M Construction Chemicals, Inc.
   b. "**1200 White**"; W. R. Meadows.
   c. "**Maxicure Resin**" white, US Spec.

I. **Bonding Compound**:
1. **Polyvinyl Acetate** (Interior Only):
   a. "**Euco Weld**"; Euclid Chemical Co.
   b. "**Weldcrete**"; Larsen Products Corp.
   c. "**Everweld**"; L & M Construction Chemicals, Inc.
   d. "**Bondcoat**", US Spec.
2. **Acrylic or Styrene Butadiene**:
   a. "**Everbond**"; L & M Construction Chemicals.
   b. **"Acryl Set**"; Master Builders.
   c. "**Acryl 60**"; Thoro.
   d. "**Daraweld C**"; W.R. Grace Construction Products Division.
   e. "**Acrylcoat**" or "Multicoat", US Spec.

J. **Epoxy Adhesive**:
1. Hilti **Hit RE 500 SD**.
2. Simpson **SET-XP**.

K. **Evaporation Control**:
1. "**E-Con**"; L & M Construction Chemicals, Inc.
2. "**Monofilm ER**", US Spec.

L. **Leveling and Topping Compound**:
1. **'Ardex SD-T'** self-drying, self-leveling concrete topping
   a. **Primer**: **'Ardex EP 2000** subsatrate preparation epoxy.
   b. **Color**: The color will be white or gray depending on how white or gray reacts with the concrete stain material. The color will be selected by the Architect.
   c. **Design Mix**: As recommended by the manufacturer's written instrauctions.
2. '**Flow-top HD**' ,US Spec
   a. **Primer**: 'Maxi-bond 2500'

## 2.2 MATERIALS

A. **Forms**:
1. **Forms for Exposed Finish Concrete**: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
   a. **Overlaid plywood** complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.

2. **Forms for Unexposed Finish Concrete**: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
3. **Forms for Textured Finish Concrete**: Units of face design, size, arrangement, and configuration to match Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners.
4. **Form Coatings**: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
5. **Form Ties**: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2 inches to surface.
   a. **Provide ties** which, when removed, will leave holes **not larger than 1 inch diameter** in concrete surface.

B. **Reinforcing Materials**:
1. **Recycled Content of Steel Products:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
2. **Reinforcing Bars:** As indicated on Structural Drawings.
   a. Bars in exterior concrete shall be epoxy coated.
3. **Steel Wire**: ASTM A 82, plain, cold-drawn steel.
4. **Welded Wire Fabric**: ASTM A 185, welded steel wire fabric.
   a. **Flat**.
5. **Supports for Reinforcement**: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
   a. **For slabs-on-grade**, use supports with sand plates or horizontal runners where base material will not support chair legs.
   b. **For exposed-to-view** concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
6. **Weldable Reinforcing Bars**: ASTM A 706

C. **Concrete**:
1. **Portland Cement**: ASTM C 150, **Type I**, typical unless noted otherwise.
   a. **Use one brand of cement** throughout project, unless otherwise acceptable to Architect.
   b. **Fly Ash**: ASTM C 618, Class F.
   c. **Normal Weight Aggregates**: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
      1) **For exterior exposed** surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
      2) **Fine Aggregates** shall comply with the following gradations:

| Sieve | Percent passing |
|---|---|
| 3/8" | 100 |
| No. 4 | 95 to 100 |
| No. 16 | 50 to 85 |
| No. 50 | 10 to 30 |
| No. 100 | 2 to 10 |

3) **Coarse Aggregates** shall comply with the following gradations:

| Sieve | Percent passing |
|---|---|
| 1-1/2" | 100 |
| 3/4" | 90 to 100 |
| 3/8" | 25 to 55 |
| No. 4 | 0 to 10 |
| No. 8 | 0 to 5 |
| No. 200 | Not to exceed 1.75 percent by weight in the combined coarse and fine aggregate. |

4) **Gradation limits**: Maximum aggregate size shall not exceed the following requirements.
   (a) 1/5 narrowest dimension between forms.
   (b) 1/3 of depth of slabs.
   (c) 3/4 of minimum clear spacing between reinforcing bars.

d. **Water**: Drinkable and complying with ASTM C 94.

D. **Admixtures**:
1. **Air-Entraining Admixture**: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. **Water-Reducing Admixture**: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
3. **Super Plasticizer**: ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.
4. **Water-Reducing, Non-Chloride Accelerator Admixture**: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
5. **Water-Reducing, Retarding Admixture**: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
6. **Prohibited Admixtures**: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. **Accessories**:
1. **Reglets**: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
2. **Non-Shrink Grout**: Grout shall be prepackaged, non-metallic, non-gaseous. It shall conform to ASTM C 1107 Grade B or C at a fluid, flow cone, consistency. Fluid grout shall attain 6500 psi compressive strength in 28 days.
3. **Absorptive Cover**: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
4. **Moisture-Retaining Cover**: One of the following, complying with ASTM C 171.
   a. **Waterproof** paper.
   b. **Polyethylene** film.
   c. **Polyethylene-coated** burlap.
5. **Liquid Membrane-Forming Curing Compound**: Liquid type membrane-forming curing compound complying with ASTM C 309, Type 1 or 1D Class B for interior and ASTM C 309 Type 2 Class A for exterior.
6. **Bonding Compound**: Polyvinyl Acetate (interior only) shall conform to ASTM C 1059 Type 1. Acrylic or styrene butadiene shall conform to ASTM C 1059 Type II.
7. **Epoxy Adhesive**: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

8. **Evaporation Control:** Monomolecular film designed to reduce rapid moisture loss during placement, float and finish operation.
9. **Under Slab Vapor Barrier:** Provide a vapor barrier equal to **'Stego' 15 mil Class A Vapor Barrier**. Vapor barrier to meet the following standards:
   a. **ASTM E 1745** - "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs". Permeance as tested after mandatory conditioning (ASTM E 1745 paragraphs 7.1.1-5): **less than 0.01 perms (gr/ft²/in-Hg)**.
   b. **ASTM D 882** - "Test Methods for Tensile Properties of Thin Plastic Sheeting": **79.6 lbf/inch**.
   c. **ASTM D 1709** - "Test Methods for Impact Resistance of Plastic Film Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor": **Method B - 2326 grams**.
   d. **ASTM F 1249** – "Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor": **0.0035 WVTR**.
   e. **ACI 302.2R-06**: "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials".

## 2.3 MIXES

A. **Proportioning and Design of Mixes**:
   1. **Prepare design mixes for each type** and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
   2. **Submit written reports to Architect and Structural Engineer** of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

B. **Design mixes** to provide normal weight concrete with a W/C ratio as indicated on the structural drawings.

C. **Suspended Slabs**: Proportion structural concrete mixture as follows:
   1. **Minimum Compressive Strength**: As indicated at 28 days.
   2. **Calculated Equilibrium Unit Weight**: As indicated, plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
   3. **Slump Limit**: As indicated on **Structural Drawings**.
   4. **Air Content**: Do not allow air content of troweled finished floors to exceed 3 percent and as indicated on Structural Drawings.

D. **Adjustment to Concrete Mixes**: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

E. **Admixtures**:
   1. **Use water-reducing admixture** or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
   2. **Use non-chloride accelerating admixture** in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
   3. **Use high-range water-reducing admixture** in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

4. **Use air-entraining admixture** in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at **manufacturer's prescribed rate** to result in concrete at point of placement having total air content **as indicated on the structural drawings.**
   a. **Concrete structures** and slabs exposed to freezing and thawing, deicer chemicals, or subjected to hydraulic pressure:
      1) **4.5 percent** (moderate exposure); **5.5 percent** (severe exposure) **1 1/2 inch maximum** aggregate. **4.5 percent** (moderate exposure); **6.0 percent** (severe exposure) **1 inch maximum aggregate.**
      2) **5.0 percent** (moderate exposure); **6.0 percent** (severe exposure) **3/4 inch maximum aggregate**.
      3) **5.5 percent** (moderate exposure); **7.0 percent** (severe exposure) **1/2 inch maximum aggregate**.
   b. **Other concrete** (not exposed to freezing, thawing, or hydraulic pressure): **2 percent to 4 percent** air.
5. **Use admixtures for water-reducing and set-control** in strict compliance with manufacturer's directions.
6. **Water-Cement Ratio**: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
   a. Subjected to **freezing and thawing**; W/C **0.50**.
   b. Subjected to **deicers/watertight**; W/C **0.45**.
   c. Subjected to **brackish water, salt spray, or deicers**; W/C **0.40**.
7. **Slump Limits**: Proportion and design mixes to result in concrete slump at point of placement as indicated.
   a. **Ramps, slabs, and sloping surfaces**: Not more than **3 inches.**
   b. **Reinforced foundation systems**: Not less than **1 inch** and not more than **3 inches**.
   c. Concrete containing super-plasticizer: Not more than 8 inches after addition of super plasticizer to site-verified 4" slump concrete.
   d. **Other concrete**: Not less than **1 inch** nor more than **4 inches**.

F. **Concrete Mixing**:
1. **Job-Site Mixing**: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
   a. **Provide batch ticket for each batch** discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
2. **Ready-Mix Concrete**: Comply with requirements of ASTM C 94, and as herein specified.
3. **During hot weather**, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. **Coordinate** the installation of **joint materials** and **vapor retarders** with placement of forms and reinforcing steel.

B. **Preparation**: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

C. **Installation Tolerances**:
1. **Slabs**: Minimum Flatness **FF of 30** and Minimum Levelness **FL of 25**.
2. **Slabs to Receive Special Finish**: Minimum Flatness **FF of 50** and Minimum Levelness **FL of 35**.
3. **Walls**: Comply with ACI requirements for horizontal, vertical, and story to story tolerances.

D. **Preparation for Sub-slab to Receive Concrete Topping**
1. **Sub-floor must be sound,** solid, cleaned and primed.
2. **All concrete sub-floors must be of adequate strength**, clean and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond-breaker before priming. Mechanically clean if necessary using shot blasting or other similar method of cleaning. Acid etching and the use of of sweeping compounds and solvents are not acceptable.
3. **All cracks in the sub-floor shall be repaired** using a product recommended by the topping slab manufacturer to minimize telegraphing though the underlayment.

## 3.2 ERECTION

A. **Forms**: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with **ACI 347**.
1. **Design formwork** to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
2. **Construct forms** to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
3. **Fabricate forms for easy removal** without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
4. **Provide temporary openings** where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
5. **Chamfer exposed corners** and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

6. **Provisions for Other Trades**: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
7. **Cleaning and Tightening**: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
8. **Preparation of Form Surfaces**:
   a. **Clean re-used forms** of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
   b. **Coat contact surfaces** of forms with a form-coating compound before reinforcement is placed.
   c. **Thin form-coating compounds** only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
   d. **Coat steel forms** with a non-staining, rust-preventative form oil or otherwise protect against rusting. **Rust-stained steel formwork is not acceptable**.

## 3.3 INSTALLATION

A. **Reinforcement**: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
1. **Avoiding cutting or puncturing vapor barrier** during reinforcement placement and concreting operations.
2. **Install** an under slab **vapor barrier** at **all slab on grade** applications.
   a. Install per ASTM E 1643 - "Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".
3. **Clean reinforcement** of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
4. **Accurately position**, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
5. **Place reinforcement** to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
6. **Install welded wire fabric** in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

B. **Concrete Placement**:
1. **Apply temporary protective covering** to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
2. **General**: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

3. **Deposit concrete continuously** or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
4. **Placing Concrete in Forms**: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. **Consolidate placed concrete** by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
    a. **Do not use vibrators** to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
    b. **Do not vibrate** forms or reinforcing steel.
6. **Placing Concrete Slabs**: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
    a. **Consolidate concrete** during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
    b. **Bring slab surfaces to correct level** with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
    c. **Maintain reinforcing in proper position** during concrete placement operations.
7. **Cold Weather Placing**: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.
    a. **When air temperature has fallen** to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
    b. **Do not use frozen materials** or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    c. **Do not use calcium chloride**, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
8. **Hot Weather Placing**: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
    a. **Cool ingredients** before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
    b. **Cover reinforcing steel** with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

c. **Fog spray forms**, reinforcing steel, and subgrade just before concrete is placed.

d. **Use water-reducing retarding admixture** (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

C. **Finishes - As indicated on Drawings**:

1. **Rough Form Finish**: Formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

2. **Smooth Form Finish**: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

   a. **Smooth Rubbed Finish**: Provide smooth rubbed finish to concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.

      1) **Moisten concrete surfaces** and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

3. **Sand Blasted Finish**: Perform sand blasting within 24 to 72 hours after casting. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be blast finished are blasted at same age for uniform results.

   a. **Depth of Cut**: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match Architect's samples, as follows:

      1) **Brush**: Remove cement matrix to expose face of fine aggregate; no reveal.

   b. **Abrasive Blasting**: Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match Architect's samples.

4. **Related Unformed Surfaces**: At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.

D. **Slab Finishes**:

1. **Scratch Finish**: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

   a. **After placing slabs**, plane surface to tolerances for floor flatness (F ) of 15 and floor levelness (F ) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

2. **Float Finish**: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
   a. **After screeding, consolidating, and leveling concrete slabs**, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F 18 - F 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
3. **Trowel Finish**: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
   a. **After floating**, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F 20 - F 17. Grind smooth surface defects which would telegraph through applied floor covering system.
4. **Trowel and Fine Broom Finish**: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
5. **Non-Slip Broom Finish**: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
   a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

E. **Joints**:
1. **Construction Joints**: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.
2. **Provide keyway**s at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
3. **Place construction joints perpendicular to main reinforcement**. Continue reinforcement across construction joints, except as otherwise indicated.
4. **Isolation Joints in Slabs-on-Ground**: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
5. **Contraction (Control) Joints in Slabs-on-Ground**: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth or inserts 1/4" wide x 1/4 of slab depth, unless otherwise indicated. **Cut construction joints** in concrete **as soon as possible** after concrete can take the weight of cutting machine, in order to allow cracks to occur at the contraction joint.
   a. **Form contraction joints** by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

b. **Contraction joints in unexposed floor slabs** may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

6. **If joint pattern not shown**, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

7. **Embedded Items**:

a. **Set and build into work anchorage devices** and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

b. **Install reglets** to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

c. **Edge Forms and Screed Strips for Slabs**: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

F. **Miscellaneous Concrete**:

1. **Filling-In**: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

2. **Curbs**: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3. **Equipment Bases and Foundations**: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

4. **Steel Pan Stairs**: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

## 3.4 CURING AND PROTECTION

A. **General**: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. **Start initial curing** as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

2. **Begin final curing** procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. **Curing Methods**: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. **Provide moisture curing** by following methods.

a. **Keep concrete surface continuously wet** by covering with water.

b. **Continuous water-fog** spray.

c. **Covering concrete surface with specified absorptive cover,** thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. **Provide moisture-cover curing** as follows:
   a. **Cover concrete surfaces** with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. **Provide curing and sealing compound** to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
   a. **Apply specified curing and sealing compound** to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
   b. **Do not use membrane curing compounds** on surfaces which are to be **covered with coating material** applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
4. **Curing Formed Surfaces**: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
5. **Curing Unformed Surfaces**: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
6. **Final cure** concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.
7. **Sealer and Dustproofer**: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

## 3.5 REMOVAL OF FORMS

A. **Formwork not supporting weight of concrete**, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. **Formwork supporting weight of concrete**, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. **Form facing material** may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

D. **Re-Use of Forms**:

1. **Clean and repair surfaces of forms** to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
2. **When forms are extended for successive concrete placement**, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

## 3.6 CONCRETE SURFACE REPAIRS

A. **Patching Defective Areas**: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

1. **Cut out honeycomb**, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
2. **For exposed-to-view surfaces**, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
3. **Repair of Formed Surfaces**: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
4. **Repair concealed formed surfaces**, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
5. **Repair of Unformed Surfaces**: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
6. **Repair finished unformed surfaces that contain defects** which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
7. **Correct high areas in unformed surfaces by grinding**, after concrete has cured at least 14 days.
8. **Correct low areas in unformed surfaces** during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

B. **Repair defective areas**, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

1. **Repair isolated random cracks** and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

C. **Perform structural repairs** with prior approval of Architect or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.

## 3.7 FIELD QUALITY CONTROL

A. **Sampling and testing** for quality control during placement of concrete may include the following, as directed by Architect.

1. **Sampling Fresh Concrete**: ASTM C 172, except modified for slump to comply with ASTM C 94.
   a. **Slump**: As indicated on the Structural Drawings.
   b. **Air Content**: As indicated on the Structural Drawings.
   c. **Concrete Temperature**: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.
2. **Compression Test Specimen**: ASTM C 31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
3. **Compressive Strength Tests**: ASTM C 39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and two specimens retained in reserve for later testing if required.
   a. **When frequency of testing** will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
   b. **When total quantity** of a given class of concrete is less than 50 cubic yards, strength test may be waived by Architect if, in his judgement, adequate evidence of satisfactory strength is provided.
   c. **When strength of field-cured cylinders** is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
   d. **Strength level of concrete** will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

B. **Test results will be reported in writing to Architect**, Structural Engineer, concrete manufacturer, Contractor and Owner's Project Manager within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

C. **Nondestructive Testing**: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

D. **Additional Tests**: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

**END OF SECTION**

# SECTION 03 3300

# CAST-IN-PLACE ARCHITECTURAL CONCRETE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section specifies** cast-in-place **architectural concrete**, including:
1. **Formwork**.
2. Reinforcement **accessories**.
3. Concrete **materials**.
4. Concrete **mix design**.
5. Placement **procedures**.
6. **Finishes**.

B. **Related Sections** include the following:
1. **Division 3** Section "**Cast-in-Place Concrete**" for structural and general cast-in-place concrete construction, including formed and unformed finishes.
2. **Division 7** Section "**Joint Sealants**" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

### 1.3 DEFINITION

A. **Cast-in-Place Architectural Concrete**: Concrete that is exposed to view on surfaces of the completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance. "Architectural Concrete" includes portions of foundation walls exposed above grade.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of manufactured material and product indicated.

B. **Design Mixes**: For each concrete mix. Include alternate mix designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. **Shop Drawings**: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie location and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. **Samples**: For each of the following materials:
1. Form-facing panel.
2. Form-release agent.
3. Form ties.
4. Form liners.
5. Cement.

6. Coarse- and fine-aggregate gradations.
7. Chamfers and rustications.
8. Curing compound.

E. **Material Test Reports**: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated, based on comprehensive testing of current materials:
1. Cementitious materials and aggregates.
2. Admixtures.
3. Curing compounds.

F. **Placement Schedule**: Submit concrete placement schedule before start of architectural concrete placement operations. Include location of all joints including construction joints.

G. Minutes of preinstallation conference.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced cast-in-place architectural concrete contractor who has specialized in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Concrete Manufacturer Qualifications**: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. **ACI Standards**: Comply with ACI 303.1, "Specification for Cast-in-Place Architectural Concrete"; ACI 301, "Specification for Structural Concrete"; and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials," unless more stringent provisions are indicated.

D. **Sample Panels**: Before casting architectural concrete, produce sample panels to demonstrate the approved range of selections made under sample Submittals. Produce a minimum of **3 sets** of full-scale sample panels, cast vertically, approximately **48 by 48 by 6 inches** (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.
1. **Locate panels** as indicated or, if not indicated, as directed by Architect.
2. **Demonstrate methods** of curing aggregate exposure, sealers, and coatings, as applicable.
3. **In presence of Architect**, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. **Maintain sample panels** during construction in an undisturbed condition as a standard for judging the completed Work.
5. **Demolish and remove** sample panels when directed.

E. **Mockups for Columns**: Before casting architectural concrete, build column mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. **Build column mockups** in the location and of the size indicated or, if not indicated, as directed by Architect.

2. **Demonstrate curing**, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
3. **In presence of Architect**, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. **Obtain Architect's approval** of mockups before casting architectural concrete columns.
5. **Approved column mockups** may become **part of the completed Work** if undisturbed at time of Substantial Completion.

F. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

A. **Form-Facing Panels for As-Cast Finishes**: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. **Forms for Cylindrical Columns**: Two (2) piece metal, or glass-fiber-reinforced plastic tubes, with applied reveals, that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Paper or fiber tubes shall not be used. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

C. **Rustication Strips (if noted on Drawings)**: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining.

D. **Chamfer Strips**: **Do not chamfer any edges** except as specifically detailed.

E. **Form Joint Tape**: Compressible foam tape, pressure sensitive, AAMA 810.1, minimum 1/4 inch (6 mm) thick.

F. **Form Joint Sealant**: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.

G. **Sealer**: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration from wood of set-retarding chemicals.

H. **Form-Release Agent**: Commercially formulated form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

I. **Form Ties**: Factory-fabricated, internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter on concrete surface.

## 2.2 REINFORCEMENT ACCESSORIES

A. **General**: Comply with **Division 3** Section "**Cast-in-Place Concrete**" for steel reinforcement and other requirements for reinforcement accessories.

## 2.3 CONCRETE MATERIALS

A. **Portland Cement**: Refer to **Division 3** Section "**Cast-In-Place Concrete**".

B. **Normal-Weight Coarse Aggregate**: Refer to **Division 3** Section "**Cast-In-Place Concrete**".

C. **Water**: Potable, complying with ASTM C 94 except free of wash water from mixer washout operations.

D. **Chemical Admixtures**: Refer to **Division 3** Section "**Cast-In-Place Concrete**".

## 2.4 CURING MATERIALS

A. **Clear, Waterborne, Liquid Membrane-Forming Curing Compound**: ASTM C 309, Type 1, Class B.

## 2.5 REPAIR MATERIALS

A. Refer to **Division 3** Section "**Cast-In-Place Concrete**".

## 2.6 CONCRETE MIXES

A. Refer to **Division 3** Section "**Cast-In-Place Concrete**".

## 2.7 CONCRETE MIXING

A. **Ready-Mixed Concrete**: Measure, batch, mix, and deliver cast-in-place architectural concrete according to ASTM C 94, and furnish batch ticket information.
   1. **When air temperature** is between **85 and 90 deg F** (30 and 32 deg C), reduce mixing and delivery time from 90 to 75 minutes; **when air temperature** is **above 90 deg F** (32 deg C), reduce mixing and delivery time to 60 minutes.

# PART 3 - EXECUTION

## 3.1 FORMWORK

A. **General**: Comply with **Division 3** Section "**Cast-in-Place Concrete**" for formwork, embedded items, and shoring and reshoring.

B. **In addition** to **ACI 303.1** limits on form-facing panel deflection, limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3 mm).

C. **Fabricate forms** for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
   1. Do not use rust-stained, steel, form-facing material.

D. **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.

E. **Chamfer exterior corners** and edges of cast-in-place architectural concrete where detailed or if not detailed chamfer edges as directed by the Architect.

F. **Coat contact surfaces** of wood rustications and chamfer strips with sealer before placing reinforcement.

G. **Form openings**, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

H. **Clean forms** and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

I. **Seal form joints** and penetrations at form ties with form joint tape or form joint sealant to prevent mortar leaks.

J. **Retighten forms** and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. **Coat contact surfaces** of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

## 3.2 REINFORCEMENT AND INSERTS

A. **General**: Comply with Division 3 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

## 3.3 REMOVING AND REUSING FORMS

A. **Formwork**, for sides of walls and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
   1. Schedule form removal to maintain surface appearance that matches approved sample panels.

B. **Clean and repair surfaces** of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

C. **When forms are reused**, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for architectural concrete surfaces.

## 3.4 JOINTS

A. **Construction Joints**: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete 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.
2. **Use bulkhead forms** with keys of plywood, wood, or expanded galvanized steel sheet, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
3. **Space vertical joints** in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
4. **Use bonding agent** at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. **Contraction Joints**: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

## 3.5 CONCRETE PLACEMENT

A. **Before placing concrete**, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. **Do not add water** to concrete during delivery, at Project site, or during placement, unless approved by Architect.

C. **Deposit concrete continuously** between construction joints. Deposit concrete to avoid segregation.

D. **Deposit concrete** in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. **Consolidate placed concrete** with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. **Do not use vibrators** to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) 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 concrete mix constituents to segregate.

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

1. **When air temperature** has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
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 indicated and approved in concrete mix designs.

F. **Hot-Weather Placement**: Place concrete according to recommendations in **ACI 305R** and as follows, when hot-weather conditions exist:

1. **Cool ingredients** before mixing to maintain concrete temperature below 90 deg F (32 deg C) 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. **Cover steel reinforcement** with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. **Fog-spray forms**, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## 3.6 FINISHES, GENERAL

A. **Architectural Concrete Finish**: Match sample panel.

B. **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.

C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

## 3.7 AS-CAST FORMED FINISHES

A. **Smooth-Formed Finish**: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height. Do not apply rubbed finish to smooth-formed finish.

## 3.8 CONCRETE CURING

A. **Protect freshly placed concrete** from premature drying and excessive cold or hot temperatures according to ACI 301.

B. **Begin curing immediately** after removing forms from concrete. Cure by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
   1. **Curing Compound**: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

## 3.9 FIELD QUALITY CONTROL

A. **General**: Comply with Division 3 Section "Concrete Work" for field quality-control requirements.

## 3.10 REPAIRS, PROTECTION, AND CLEANING

A. **Repair and cure** damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
   1. **Remove and replace** cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. **Protect corners**, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. **Protect cast-in-place architectural concrete** from staining, laitance, and contamination during remainder of construction period.

D. **Clean cast-in-place architectural concrete** surfaces after finish treatment to remove stains, markings, dust, and debris.

E. **Wash and rinse** surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
   1. **Do not use cleaning materials** or processes that could change the appearance of cast-in-place architectural concrete finishes.

F. **Caulk joints** to protect against sand and temperature induced heaving.

**END OF SECTION**

# SECTION 03 4500

# PRE-CAST ARCHITECTURAL CONCRETE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes**, but are not limited to, the following:
1. Pre-cast **concrete lintels, sills** and **jamb** pieces.
2. Pre-cast **wall caps**.
3. Pre-cast **accent** pieces
4. Other pre-cast pieces as indicated on Drawings.

### 1.3 DEFINITIONS

A. **Architectural Pre-cast Concrete**: Building units intended to simulate natural cut stone.

### 1.4 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for precast concrete units.

B. **Shop Drawings**: Show fabrication and installation details for pre-cast concrete units. Include dimensions; details of reinforcement and anchorages, if any; and indication of finished faces.
1. Include building elevations showing layout of units and locations of joints and anchors.

C. **Samples**: For each color and texture of pre-cast concrete required, 10 inches (250 mm) square in size.

D. **Design Mixes**: For each concrete mix.

E. **Qualification Data**: For firms and persons specified in Quality Assurance Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

### 1.5 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A firm experienced in manufacturing pre-cast concrete units similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units.

B. **Source Limitations for Architectural Pre-cast Concrete**: Obtain pre-cast concrete units through one source from a single manufacturer.

C. **Source Limitations for Mortar Materials**: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. **Mockups**: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Coordinate delivery** of pre-cast concrete with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

B. **Pack, handle, and ship** pre-cast concrete units in suitable packs or pallets.
1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move pre-cast concrete units, if required, using dollies with wood supports.
2. Store pre-cast concrete units on wood skids or pallets with non-staining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. **Store installation materials** on elevated platforms, under cover, and in a dry location.

D. **Store mortar aggregates** where grading and other required characteristics can be maintained and contamination can be avoided.

## 1.7 PROJECT CONDITIONS

A. **Cold-Weather Requirements**: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. **Cold-Weather Cleaning**: Use liquid cleaning methods only when air temperature is 40 deg F4 deg C and above and will remain so until precast concrete has dried, but not less than 7 days after completing cleaning.

B. **Hot-Weather Requirements**: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. **Brailsford** Cast Stone, Inc.
2. **Eagle** Pre-cast.
3. **Classic Cast Stone** of Dallas, Inc.
4. **Continental Cast Stone** Manufacturing, Inc.
5. **Pineapple Grove** Designs.

## 2.2 PRE-CAST CONCRETE MATERIALS

A. **General**: Comply with ASTM C 1364 and the following:
   1. **Portland Cement**: ASTM C 150, Type I or Type II, natural color, white, or a blend to produce color indicated, and containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
   2. **Coarse Aggregates**: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures.
   3. **Fine Aggregates**: Manufactured or natural sands complying with ASTM C 33, gradation as needed to produce required textures.
      a. **Provide Wyoming white sand** or other aggregate as approved by Architect.

B. **Air-Entraining Admixture**: ASTM C 260, certified by the manufacturer to be compatible with other admixtures used.
   1. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 5 to 7 percent.

C. **Reinforcement**: Deformed steel bars complying with ASTM A 615/A 615M.
   1. Epoxy Coating: ASTM A 775/A 775M.

D. **Embedded Anchors and Other Inserts**: Fabricated from stainless steel complying with ASTM A 276 or ASTM A 666, Type 304.

## 2.3 PRE-CAST CONCRETE UNITS

A. **Provide pre-cast concrete units** complying with ASTM C 1364.
   1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.

B. **Reinforce units** as indicated and as required by ASTM C 1364. Use epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of material.

C. **Fabricate units** with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated.
   1. Slope exposed horizontal surfaces at least 1:12, unless otherwise indicated.
   2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
   3. Provide drips on projecting elements, unless otherwise indicated.

D. **Cure and finish units as follows**:
   1. Cure units in totally enclosed curing room under dense fog and water spray at 95 percent relative humidity for 24 hours.
   2. Yard cure units until the sum of the mean daily temperatures for each day equals or exceeds 350 deg F.
   3. Acid etch units to remove cement film from surfaces indicated to be finished.

E. **Colors and Textures**: As selected by Architect from manufacturer's full range for these characteristics. Submit samples for Architect’s approval.
   1. Finish all exposed surfaces of pre-cast concrete units to match face-surface finish.
      a. Finish unexposed surfaces of pre-cast concrete units by float finish.

## 2.4 MORTAR MATERIALS

A. **Portland Cement**: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color, white, or a blend to produce mortar color indicated.

B. **Hydrated Lime**: ASTM C 207, Type S.

C. **Mortar Aggregate**: ASTM C 144.
   1. White-Mortar Aggregates: Natural, white sand or ground, white stone.

D. **Water**: Potable.

## 2.5 ACCESSORIES

A. **Anchors**: Type and size indicated, fabricated from stainless steel complying with ASTM A 276 or ASTM A 666, Type 304.

B. **Dowels**: Round stainless steel bars complying with ASTM A 276, Type 304, 1/2-inch (12-mm) diameter.

## 2.6 MORTAR MIXES

A. **Setting Mortar**: Comply with ASTM C 270, Proportion Specification, Type S.
   1. Limit cementitious materials to Portland cement and lime.
   2. Colored-Aggregate Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of precast concrete.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. **Set pre-cast concrete** as indicated on Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

B. **Drench units** with clear water just before setting.

C. **Set units in full bed of mortar** with full head joints, unless otherwise indicated. Build anchors and ties into mortar joints as units are set.
   1. Fill dowel holes and anchor slots with mortar.
   2. Fill collar joint solid as units are set.

3. Build concealed flashing into mortar joints as units are set.
4. Leave head joints open in coping and other units with exposed horizontal surfaces. Keep joints clear of mortar, and rake out to receive sealant.

D. **Rake out joints** for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

E. **Point mortar joints** by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

F. **Tool exposed joints slightly concave** when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

G. **Provide expansion**, control, and pressure-relieving joints of widths and at locations indicated.
1. **Sealing joints** is specified in **Division 7** Section "**Joint Sealants**."
2. **Keep joints free of mortar** and other rigid materials.

## 3.3 INSTALLATION TOLERANCES

A. **Variation from Plumb**: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.

B. **Variation from Level**: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.

C. **Variation in Joint Width**: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.

D. **Variation in Plane between Adjacent Surfaces (Lipping)**: Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

## 3.4 ADJUSTING AND CLEANING

A. **Remove and replace stained** and otherwise damaged units and units not matching approved Samples. Pre-cast concrete may be repaired if methods and results are approved by Architect.

B. **Replace units** in a manner that results in pre-cast concrete matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. **In-Progress Cleaning**: Clean pre-cast concrete as work progresses. Remove mortar fins and smears before tooling joints.

D. **Final Cleaning**: After mortar is thoroughly set and cured, clean exposed precast concrete as follows:

1. **Remove large mortar particles** by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. **Protect adjacent surfaces** from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
3. **Wet wall surfaces** with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
4. **Clean pre-cast concrete** with proprietary acidic cleaner applied according to manufacturer's written instructions.

**END OF SECTION**

# DIVISION 4 - MASONRY


| | |
|---|---|
| Section 04 2100 | Brick Veneer |
| Section 04 2200 | Unit Masonry Assemblies |
| Section 04 4300 | Dimension Stone Cladding |

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# SECTION 04 2100

# BRICK VENEER

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** unit masonry assemblies consisting of the following:
   1. **Brick** veneer.
   2. **Mortar** and **grout**.
   3. Miscellaneous masonry **accessories**.

B. **Related Sections** include the following:
   1. **Division 7** Section "**Water Repellents**" for sealers and anti-graffiti coatings.
   2. **Division 7** Section "**Sheet Metal Flashing and Trim**" for exposed sheet metal flashing.

C. **Products installed, but not furnished**, under this Section include the following:
   1. **Steel lintels** and **shelf angles** for unit masonry, furnished under **Division 5** Section "**Metal Fabrications**."
   2. **Rigid cavity wall insulation**, furnished under **Division 7** Section "**Building Insulation**."
   3. **Manufactured reglets** in masonry joints for metal flashing, furnished under **Division 7** Section "**Sheet Metal Flashing and Trim**."
   4. **Hollow-metal frames** in unit masonry openings, furnished under **Division 8** Section "**Hollow Metal Doors and Frames**."

### 1.3 SUBMITTALS

A. **Product Data**: For each different masonry unit, accessory, and other manufactured product specified.

B. **Shop Drawings**: Show fabrication and installation details for the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
   4. Anchor System: Size, type, placement and other features.

C. **Delegated Design/Deferred Submittal:** For masonry anchor system. Show design calculations.

D. **Samples:** Pigmented mortar, minimum 3 inches long and width of typical joint. Make samples using same sand and mortar ingredients to be used on Project.

E. **Cold-Weather Procedures**: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

## 1.4 PERFORMANCE REQUIREMENTS

A. **Delegated Design:** Engage a qualified professional engineer to design masonry anchorage system.

B. **General:** Design masonry anchors and anchoring systems according to ASTM C 1242 and as required to accommodate loads and stresses indicated on Structural Drawings.

## 1.5 QUALITY ASSURANCE

A. **Source Limitations for Masonry Units**: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

B. **Source Limitations for Mortar Materials**: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

C. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

D. **Mockups**: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. **Locate mockups** in the locations indicated or, if not indicated, **as directed by Architect.**
2. **Build mockups** for the following types of masonry in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness using mortar in colors as selected by Architect.
   a. **Each type of exposed unit** masonry construction.
3. **Clean exposed faces** of mockups with masonry cleaner as indicated.
4. Where **masonry is to match existing**, **erect** mockups **adjacent** and parallel **to existing surface.**
5. **Notify Architect seven days in advance** of dates and times when mockups will be constructed.
6. **Protect accepted mockups** from the elements with weather-resistant membrane.
7. **Maintain mockups** during construction in an undisturbed condition as a standard for judging the completed Work.
8. **Approval of mockups is for color, texture, and blending of masonry units;** relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
9. **Demolish and remove mockups** when directed.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Store masonry units on elevated platforms** in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
   1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. **Store cementitious materials on elevated platforms**, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. **Store aggregates where grading and other required characteristics can be maintained** and contamination avoided.

D. **Store masonry accessories**, including metal items, **to prevent corrosion** and accumulation of dirt and oil.

## 1.7 PROJECT CONDITIONS

A. **Protection of Masonry**: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work, except when the ambient temperature is expected to remain above 65 deg F and no rain is forecast for the next 24 hours. (This is to prevent condensation from covered walls causing a moisture problem.) Cover partially completed masonry each day that construction is not in progress. Walls are to be protected until they are permanently protected by the roofing membrane over the cap plate. The General Contractor is to provide temporary protection immediately following the topping out of each section of wall by installing waterproof sheeting over the cap plate until the roofing membrane is installed. Temporary covers shall extend at least 24 inches down both sides the top of wall, projection or sill
   1. **Extend cover** a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
   2. **Protection shall remain in place** until final weatherproof covering has been installed. Once masonry work has commenced the Contractor shall reimburse the Owner the sum of **$500.00 per day** that the masonry work is not protected.

B. **Stain Prevention**: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. **Protect base of walls** from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
   2. **Protect sills, ledges, and projections** from mortar droppings.
   3. **Protect surfaces of window and door frames**, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. **Cold-Weather Requirements**: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in Section 2104.3 of the Uniform Building Code.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. **Hot-Weather Requirements**: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
   1. When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

## PART 2 - PRODUCTS

### 2.1 BRICK VENEER

A. **General**: Provide shapes indicated and as follows for each form of brick required:
   1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.

B. **Special Shapes**: Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
   1. **Provide special shapes** for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
   2. **Provide special shapes** for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. **Brick Veneer**: ASTM C 216, Grade SW, Type FBX, and as follows:
   1. **Unit Compressive Strength:** Provide units with minimum average net-area compressive strength of 8000 psi (55.2 MPa).
   2. **Initial Rate of Absorption:** Less than 20 g/30 sq. in. (20 g/194 sq. cm) per minute when tested per ASTM C 67.
   3. **Efflorescence:** Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
   4. **Size:** Manufactured to sizes shown on Drawings and per University standards.
   5. **Application**: Use where brick is exposed, unless otherwise indicated.
   6. **Color and Texture: Match University standard and existing Stromberg Arena brick.**

## 2.2 MORTAR AND GROUT MATERIALS

A. **Portland Cement**: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Where no mortar color is indicated on the Drawings, **Architect shall select color(s)** from manufacturer's full range.
   2. Free alkali in cements used in mortar shall be less than 0.1 percent to avoid efflorescence.

B. **Hydrated Lime**: ASTM C 207, Type S.

C. **Aggregate for Mortar**: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

D. **Aggregate for Grout**: ASTM C 404.

E. **Mortar Pigments**: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
   1. **Provide multiple colors** as selected by the Architect. Locate each color where directed by the Architect.

F. **Epoxy Pointing Mortar**: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of the units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

G. **Water**: Potable.

## 2.3 ADJUSTABLE MASONRY-VENEER ANCHORS

A. **General**: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to metal studs, and as follows:
   1. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

B. **Seismic Masonry-Veneer Anchors:** Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint, complying with the following requirements:
   1. **Anchor Section:** Gasketed 14 gage hot-dip galvanized sheet metal back plate with screw holes top and bottom; "L" shaped with slotted opening to accommodate wire tie.
      a. **Backplate** shall be sized to accommodate 2-1/2 inch insulation; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more then 1/32 inch (0.8 mm).
      b. Install insulation using manufacturer's "Wedgelock" insulation washer, 14 gage metal plate, or Architect approved equivalent.

c. **Provide** anchor manufacturer's standard, self-adhering, modified bituminous **gaskets** manufactured to fit behind anchor plate and to prevent moisture from penetrating sheathing at screw holes.

2. **Connector Section:** Rectangular wire tie with snap-in grooves for inserting continuous wire (H-B "Byna-Lok Wire Tie"). Size wire tie to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face.
   a. Fabricate wire connector sections from minimum 0.1875-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
3. **Continuous Wire:** Minimum 0.1875-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
4. **Basis of Design: SBRA Seismic Veneer Anchor System** as manufactured by **Hohmann and Barnard**, Inc.; www.h-b.com.

C. **Steel Drill Screws for Steel Studs**: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:
1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

## 2.4 EMBEDDED FLASHING MATERIALS

A. **Metal Flashing**: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
1. Copper: 10-oz./sq. ft. (3-kg/sq. m) weight or 0.0135 inch (0.34 mm) thick for fully concealed flashing; 16-oz./sq. ft. (5-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick elsewhere.
2. Drip Edge: Fabricate metal drip edges from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with a hemmed outer edge bent down 30 degrees.

B. **Contractor's Option for Concealed Flashing**: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use the following, unless otherwise indicated:
1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. (1.5-kg/sq. m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

C. **Adhesives, Primers, and Seam Tapes for Flashings**: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.5 MISCELLANEOUS MASONRY ACCESSORIES

A. **Compressible Filler**: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. **Preformed Control-Joint Gaskets**: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. **Styrene-Butadiene-Rubber Compound**: ASTM D 2000, Designation M2AA-805.

D. **Bond-Breaker Strips**: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).Retain one or more of first six paragraphs below, or delete all if open-head joints are used for weep holes and vents.

E. **Cellular Plastic Weep/Vent:** One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected by Architect from manufacturer's standard colors.

F. **Cavity Drainage Material**: Not less than 1-inch- (25-mm-) thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

## 2.6 MASONRY CLEANERS

A. **Job-Mixed Detergent Solution**: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

## 2.7 MORTAR AND GROUT MIXES

A. **General**: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

B. **Calcium Chloride**: Do not use calcium chloride in mortar or grout

C. **Mortar for Unit Masonry**: Comply with ASTM C 270, Proportion Specification Type M as indicated on drawings.

D. **Pigmented Mortar**: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
   1. For mineral-oxide pigments and Portland cement-lime mortar, not more than 10 percent.

E. **Grout for Unit Masonry**: Comply with ASTM C 476 as indicated on the drawings.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
   2. Verify that substrates are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

## 3.2 INSTALLATION, GENERAL

A. **Thickness**: Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. **Wetting of Masonry Units**: Wet masonry units before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

## 3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

E. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

## 3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. **Bond Pattern for Exposed Masonry**: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
   1. One-third running bond with vertical joint in each course centered on units in courses above and below.

C. **Stopping and Resuming Work**: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

D. **Built-in Work**: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

## 3.5 MORTAR BEDDING AND JOINTING

A. **Lay solid masonry units in full bed of mortar**, with full head joints, uniformly jointed with other work.

B. **Buttering corners** of joints or **excessive furrowing** of mortar joints is **not permitted**.

C. **Remove excess mortar** and mortar smears as work progresses.

D. **Interlock** intersections and external corners.

E. **Do not shift or tap masonry units** after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
   1. Tool exposed joints as follows, unless otherwise indicated:
      a. Smooth/standard face masonry, Kerfed/honed face masonry, and Split-Face masonry: Slightly concave using a jointer larger than joint thickness.

## 3.6 CONTROL AND EXPANSION JOINTS

A. **General**: Install control and expansion joints in veneer where indicated, or if not indicated place at a maximum of 20’-0” on center and within 5'-4" from the corners - locate as directed by the Architect. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Build in horizontal, pressure-relieving joints where indicated or if not indicated place at a maximum of 12'-0" on center vertically and locate as directed by the Architect. Construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

## 3.7 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

## 3.8 INSULATION

A. **Installing Cavity-Wall Insulation:** Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose or other method as recommended by insulation manufacturer. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry
   2. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified herein.

## 3.9 FLASHING, WEEP HOLES, AND VENTS

A. **General**: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. **Preparation**: Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:
   1. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn flashing up not less than 2 inches (50 mm) to form a pan.
   2. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.

D. Install weeps in the head joints in exterior wythes of the first course and at top of masonry immediately above embedded flashing and as follows:
   1. Space weeps 32 inches (800 mm) o.c.

## 3.10 REPAIRING, POINTING, AND CLEANING

A. **General**: Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. **Pointing**: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. **In-Progress Cleaning**: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. **Final Cleaning**: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.

E. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.

## 3.11 MASONRY WASTE DISPOSAL

A. **Excess Masonry Waste**: Remove excess masonry waste and legally dispose of off Owner's property.

**END OF SECTION**

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# SECTION 04 2200

# UNIT MASONRY ASSEMBLIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** unit masonry assemblies consisting of the following:
1. **Concrete masonry units** (CMU).
2. **Decorative** concrete masonry units.
3. **Mortar** and **grout**.
4. **Reinforcing** steel.
5. **Masonry joint** reinforcement.
6. **Miscellaneous** masonry accessories.
7. **Masonry-cell** insulation.

B. **Related Sections** include the following:
1. **Division 7** Section "**Sheet Metal Flashing and Trim**" for exposed sheet metal flashing.
2. **Division 7** Section "**Firestopping**" for firestopping at tops of masonry walls and at openings in masonry walls.

C. **Products installed, but not furnished**, under this Section include the following:
1. Steel **lintels** and **shelf angles** for unit masonry, furnished under **Division 5** Section "**Metal Fabrications**."
2. **Manufactured reglets** in masonry joints for metal flashing, furnished under **Division 7** Section "**Sheet Metal Flashing and Trim**."
3. **Hollow-metal frames** in unit masonry openings, furnished under **Division 8** Section "**Steel Doors and Frames**."

### 1.3 DEFINITIONS

A. **Reinforced Masonry**: Masonry containing reinforcing steel in grouted cells.

### 1.4 PERFORMANCE REQUIREMENTS

A. **Provide unit masonry** that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
1. **For Concrete Unit Masonry**: **f'm = 1500 psi.**

### 1.5 SUBMITTALS

A. **Product Data**: For each different masonry unit, accessory, and other manufactured product specified.

B. **Shop Drawings**: Show fabrication and installation details for the following:
   1. **Reinforcing Steel**: Detail bending and placement of unit masonry reinforcing bars. Comply with **ACI 315, "Details and Detailing of Concrete Reinforcement**."

C. **Samples:** Pigmented mortar, minimum 3 inches long and width of typical joint. Make samples using same sand and mortar ingredients to be used on Project.

D. **Material Test Reports**: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
   1. **Each type of masonry** unit required.
      a. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.
   2. **Mortar** complying with property requirements of ASTM C 270.
   3. **Grout** mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.
   4. **Fire Resistive Rating**: Provide test report as per ASTM Sandard E-119 for rated masonry walls as indicated on the drawings.

E. **Material Certificates**: Signed by manufacturers certifying that each of the following items complies with requirements:
   1. **Each type of masonry** unit required.
      a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
   2. **Each cement product** required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
   3. **Each combination of masonry** unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in **ACI 530.1/ASCE 6/TMS 602**.
   4. **Each material** and grade indicated for reinforcing bars.
   5. **Each** type and size of **joint reinforcement**.
   6. **Each** type and size of **anchor, tie,** and **metal accessory**.

F. **Cold-Weather Procedures**: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements as per **TMS 602-08/ACI 530.1-08/ASCE 6-08.**

## 1.6 QUALITY ASSURANCE

A. **Testing Agency Qualifications**: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. **Source Limitations for Masonry Units**: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. **Source Limitations for Mortar Materials**: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. **Preconstruction Testing Service**: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
   1. **Concrete Masonry Unit Test**: For each concrete masonry unit indicated, per ASTM C 140.
   2. **Mortar Test**: For mortar properties per ASTM C 270.
   3. **Grout Test**: For compressive strength per ASTM C 1019.

E. **Fire-Resistance Ratings**: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

F. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

G. **Factory Selection and Blending of Integrally Colored Masonry:**
   1. Where manufacturing process allows variance in color, manufacturer shall create a dry-laid mockup demonstrating full range of color for Architect review. Mockup shall include at least three blocks of each color hue. Architect shall select the allowable color range from block in factory dry-laid mockup.
   2. Pallets shall be mixed at factory before being shipped to project site. Masonry units which exceed the color range determined by the Architect shall be rejected at the factory and not included in the pallets used at project site.
   3. Masonry units used in actual construction of building which exceed the allowable color range shall be removed and replaced at Contractor's expense.

H. **Mockups**: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. **Locate mockups** in the locations indicated or, if not indicated, as directed by Architect.
   2. **Build mockups** for the following types of masonry in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.
      a. **Each type** of exposed unit masonry construction.
      b. **Typical exterior wall** with lower corner of window opening framed with stone trim at upper corner of mockup. Make opening approximately 12 inches wide by 16 inches high
      c. **Mortar color(s) as selected** by Architect.
   3. **Clean exposed faces** of mockups with masonry cleaner as indicated. Cleaning mockups are not permitted on the finished structure.
   4. **Notify Architect** seven days in advance of dates and times when mockups will be constructed.
   5. **Protect accepted mockups** from the elements with weather-resistant membrane.
   6. **Maintain mockups** during construction in an undisturbed condition as a standard for judging the completed Work.

7. **Approval of mockups** is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. **Approval of mockups** does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
8. **Demolish and remove** mockups when directed.
9. **Approved mockups may become part of the completed Work** (except for mockups used to demonstrate cleaning techniques) if undisturbed at time of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Store masonry units** on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. **Store cementitious materials** on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. **Store aggregates** where grading and other required characteristics can be maintained and contamination avoided.

D. **Store masonry accessories**, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.8 PROJECT CONDITIONS

A. **Protection of Masonry**: During construction, **cover tops of walls**, projections, and sills with waterproof sheeting at end of each day's work, except when the ambient temperature is expected to remain above 65 deg F and no rain is forecast for the next 24 hours. (This is to prevent condensation from covered walls causing a moisture problem.) **Cover partially completed masonry each day that construction is not in progress**. Walls are to be protected until they are **permanently protected by the roofing membrane** over the cap plate. The General Contractor is to provide temporary protection immediately following the topping out of each section of wall by installing waterproof sheeting over the cap plate until the roofing membrane is installed. **A solid grouted top bond beam shall not be considered adequate protection for the wall.**
   1. **Extend cover** a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
   2. **Protection shall remain in place** until final weatherproof covering has been installed. Once masonry work has commenced the Contractor shall reimburse the Owner the sum of **$500.00 per day** that the masonry work is not protected.

B. **Do not apply uniform floor or roof loads** for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. **Stain Prevention**: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. **Protect base of walls** from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.

2. **Protect sills**, ledges, and projections from mortar droppings.
3. **Protect surfaces of window** and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. **Turn scaffold boards near the wall on edge** at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
5. **Provide temporary edge on floor slabs** to prevent moisture from draining over the edge of the floor slabs and down walls

D. **Cold-Weather Requirements**: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in **TMS 602-08/ACI 530.01/ASCE 6-08** as referenced in the International Building Code, section 2104.3 when ambient temperature is 40 degrees F or below.

1. **Cold-Weather Cleaning**: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
2. **Comply with the following requirements during construction** when the following **ambient air temperatures** exist:
   a. **40 deg. F to 32 deg. F**: Heat sand **or** mixing water to produce mortar temperature between 40 deg. F and 120 deg. F at the time of mixing. Grout does not require heated materials, unless the temperature of the materials is below 32 deg. F.
   b. **Below 32 deg F to 25 deg. F** : Heat sand **and** mixing water to produce mortar temperature between 40 deg. F and 120 deg F at the time of mixing. Maintain mortar temperature above freezing until used in masonry. Heat grout aggregates and mixing water to produce grout temperature between 70 deg. F and 120 deg. F at the time of mixing. Maintain grout temperature above 70 deg. F at the time of grout placement.
   c. **Below 25 deg. F to 20 deg. F**: Comply with paragraph 1.8 D.2.b above and the following: **Heat masonry surfaces** under construction to 40 deg. F. and **use wind breaks or enclosures** when the wind velocity exceeds 15 mph. Heat masonry to a minimum of 40 deg. F prior to grouting.
   d. **Below 20 deg. F:** Comply with paragraph 1.8 D.2.c above and the following: **Provide an enclosure and auxiliary heat** to maintain air temperature above 32 deg. F within the enclosure.
3. **Comply with the following** requirements **after masonry is placed** when the following **minimum daily temperatures** exist:
   a. **40 deg. F to 25 deg F**: Protect newly constructed masonry by covering with a weather-resistive membrane for 24 hours after completion.
   b. **Below 25 deg F to 20 deg. F**: Cover newly constructed masonry completely with weather-resistive insulating blankets, or equal protection, for 24 hours after completion of work. Extend time period to 48 hours for grouted masonry, unless the only cement in the grout is Type III Portland cement.
   c. **Below 20 deg. F**: Maintain newly constructed masonry temperature above 32 deg. F for at least 24 hours after being completed by using heated enclosures, electric heating blanket, infrared lamps, or other means acceptable to the Architect. Extend time period to 48 hours for grouted masonry, unless the only cement in the grout is Type III Portand cement.

E. **Hot-Weather Requirements**: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Comply with hot-weather construction requirements contained in TMS 602-08/ACI 530.01/ASCE 6-08 as referenced in the International Building Code, section 2104.3 when ambient temperature exceeds 100 degrees F.

1. **When ambient temperature exceeds 100 deg F** (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.
2. **Maintain temperature** of grout and mortar **below 120 deg. F**. Maintain sand piles in a damp, loose condition.
3. **When the mean daily temperature exceeds 100 deg. F** or exceeds 90 deg. F with a wind velocity greater than 8 mph, **fog spray** newly constructed masonry until damp, at least 3 times per day until the masonry is 3 days old.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

A. **Defective Units**: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

### 2.2 CONCRETE MASONRY UNITS

A. **General**: Provide shapes indicated and as follows:

1. **Provide special shapes** for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
2. **At interior walls**, provide **chamfered units** for outside corners, unless otherwise indicated.

B. **Concrete Masonry Units**: ASTM C 90-00 and as follows (standard units)

1. **Unit Compressive Strength**: Provide units with minimum average net-area compressive strength of **2500 psi**.
2. **Weight Classification**: **Light** weight. (Minimum weight of **103 lbs** per cu. ft.)
3. **Size** (Width): Manufactured to the following dimensions:
   a. **6 inches** (152 mm) nominal, 5 5/8 inches (151 mm) actual.
   b. **8 inches** (203 mm) nominal; 7-5/8 inches (194 mm) actual.
   c. **10 inches** (254 mm) nominal; 9-5/8 inches (245 mm) actual.
   d. **12 inches** (305 mm) nominal; 11-5/8 inches (295 mm) actual.
4. **Exposed Faces**: Manufacturer's standard color and texture, unless otherwise indicated.
   a. Where units are to be left exposed, provide color and texture matching the range represented by Architect's sample.

C. **Decorative Concrete Masonry Units**: ASTM C 90-00 and as follows:
   1. **Unit Compressive Strength**: Provide units with minimum average net-area compressive strength of **2500 psi**.
   2. Weight Classification: **Medium** weight. (Minimum weight of **115 lbs** per cu. ft.)
   3. **Provide Type I**, moisture-controlled units
   4. **Size**: Manufactured to dimensions indicated for non-decorative units.

## 2.3 MORTAR AND GROUT MATERIALS

A. **Portland Cement**: ASTM C 150, **Type I or II,** except **Type III** may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Where no mortar color is indicated on the Drawings, **Architect shall select color(s)** from manufacturer's full range.
   2. Free alkali in cements used in mortar shall be less than 0.1 percent to avoid efflorescence.

B. **Hydrated Lime**: ASTM C 207, **Type S**.

C. **Aggregate for Mortar**: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

D. **Aggregate for Grout**: ASTM C 404.

E. **Mortar Pigments**: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
   1. **Provide multiple colors** as selected by the Architect. Locate each color where directed by the Architect.

F. **Epoxy Pointing Mortar**: ASTM C 395, epoxy resin based material formulated for use as pointing mortar for structural clay tile facing units (and approved for such use by manufacturer of the units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors

G. **Water**: Potable.

## 2.4 REINFORCING STEEL

A. **Uncoated Steel Reinforcing Bars**: ASTM A 615 **Grade 60**.

## 2.5 MASONRY JOINT REINFORCEMENT

A. **General**: ASTM A 951 and as follows:
   1. **Hot-dip galvanized**, carbon-steel wire for both interior and exterior walls.
   2. **Wire Size for Side Rods**: W1.7 or 0.148-inch (3.8-mm) diameter.
   3. **Wire Size for Cross Rods:** W1.7 or 0.148-inch (3.8-mm) diameter.
   4. **Provide in lengths of not less than 10 feet** (3 m), with prefabricated corner and tee units where indicated.

B. **For single-wythe masonry**, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.

## 2.6 MISCELLANEOUS ANCHORS

A. **Anchor Bolts**: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
   1. **Non-headed bolts**, bent in manner indicated.

B. **Postinstalled Anchors**: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. **Type:** Expansion anchors.
   2. **Corrosion Protection:** Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
   3. **For Post-installed Anchors in Concrete**: Capability to sustain, without failure, a load equal to **four times the loads imposed**.
   4. **For Post-installed Anchors in Grouted Masonry Units**: Capability to sustain, without failure, a load equal to **six times the loads imposed.**

## 2.7 EMBEDDED FLASHING MATERIALS

A. **Metal Flashing**: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
   1. **Copper:** 10-oz./sq. ft. (3-kg/sq. m) weight or 0.0135 inch (0.34 mm) thick for fully concealed flashing; 16-oz./sq. ft. (5-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick elsewhere.
   2. **Fabricate metal drip edges** from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with a hemmed outer edge bent down 30 degrees.

B. **Contractor's Option for Concealed Flashing**: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use the following, unless otherwise indicated:
   1. **Copper-Laminated Flashing**: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. (1.5-kg/sq. m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

C. **Adhesives, Primers, and Seam Tapes for Flashings**: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. **Compressible Filler**: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. **Preformed Control-Joint Gaskets**: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
   1. **Styrene-Butadiene-Rubber Compound**: ASTM D 2000, Designation M2AA-805.Delete subparagraph above or below.

C. **Bond-Breaker Strips**: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. **Cellular Plastic Weep/Vent:** One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

E. **Cavity Drainage Material**: Not less than 1-inch- (25-mm-) thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

## 2.9 MASONRY-CELL INSULATION

A. **Foamed-In-Place Masonry Insulation**: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.
   1. **Surface Burning Characteristics**: Maximum flame spread, smoke developed and fuel contributed of 0, 5 and 0 respectively.
   2. **Combustion Characteristics**: Must be noncombustible, Class A building material.
   3. **Thermal Values**: "R" Value of 4.91/inch @ 32 degrees F mean; ASTM C-177.
   4. **Sound Abatement: Minimum Sound Transmission Class** ("STC") rating of 53 and a minimum Outdoor Indoor Transmission Class ("OITC") rating of 44 for 8" wall assembly (ASTM E 90-90).
   5. **Foamed-In-Place Masonry Insulation**: Subject to compliance with requirements, available manufacturers include, but are not limited to:
      a. **Core-Fill 500(TM)** Tailored Chemical Products P.O. Drawer 4186 Hickory, N.C. 28603 (800) 627-1687.

## 2.10 MASONRY CLEANERS

A. **Job-Mixed Detergent Solution**: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

## 2.11 MORTAR AND GROUT MIXES

A. **General**: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. **Do not use calcium chloride** in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, Type M.

C. **Pigmented Mortar**: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
   1. **For mineral-oxide pigments** and portland cement-lime mortar, not more than **10 percent**.

D. **Grout for Unit Masonry**: Comply with ASTM C 476, **type as indicated on the structural drawings**.

E. **Epoxy Pointing Mortar**: Mix epoxy pointing mortar to comply with mortar manufacturer's directions.

F. Contractor to provide **custom colored** mortar and grout for each color of block specified.

## 2.12 SOURCE QUALITY CONTROL

A. **Owner reserves the right to engage** a qualified independent testing agency to perform source quality-control testing indicated below.
   1. **Payment** for these services will be made **by Owner**.
   2. **Re-testing** of materials failing to meet specified requirements shall be done at **Contractor's** expense.

B. **Concrete Masonry Unit Tests**: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine conditions**, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. **For the record, prepare written repor**t, endorsed by Installer, listing conditions detrimental to performance.
   2. **Verify that substrates** are within tolerances specified.
   3. **Verify that reinforcing dowels** are properly placed.
   4. **Proceed with installation** only after unsatisfactory conditions have been corrected.

B. **Before installation**, examine rough-in and built-in construction to verify actual locations of piping connections.

## 3.2 INSTALLATION, GENERAL

A. **Thickness**: Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. **Build chases** and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. **Leave openings** for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. **Cut masonry units** with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. **Select and arrange units** for exposed unit masonry to produce a uniform blend of colors and textures.
   1. **Mix units** from several pallets or cubes as they are placed.

F. **Wetting of Masonry**: Wet masonry before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying. Do not overwet masonry so as to promote efflorescence.

G. **Cover sheathing** with infiltration barrier as follows:
   1. **Install in accordance with Manufacturer's instructions** over exterior sheathing. Seal joints and penetrations through air infiltration barrier with specified tape prior to installation of finish material. Air infiltration barrier shall be air tight and free from holes, tears, and punctures. All window and door penetrations shall be taped.
   2. **Apply infiltration barrier** to cover upstanding flashing with 4-inch overlap.

## 3.3 CONSTRUCTION TOLERANCES

A. **Comply** with tolerances in **ACI 530.1/ASCE 6/TMS 602** and the following:

B. **For conspicuous vertical lines**, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

C. **For vertical alignment of exposed head joints**, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.

D. **For conspicuous horizontal lines**, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

E. **For exposed head joints**, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

## 3.4 LAYING MASONRY WALLS

A. **Lay out walls** in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. **Bond Pattern for Exposed Masonry**: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
   1. **One-half running bond** with vertical joint in each course centered on units in courses above and below.

C. **Lay concealed masonry** with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. **Stopping and Resuming Work**: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. **Built-in Work**: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. **Fill space** between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. **Where built-in items are to be embedded** in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. **Fill cores** in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. **Build non-load-bearing** interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. **Install compressible filler** in joint between top of partition and underside of structure above.
   2. **At fire-rated partitions,** install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

## 3.5 MORTAR BEDDING AND JOINTING

A. **Lay hollow masonry units as follows**:
   1. **With full mortar coverage** on horizontal and vertical face shells.
   2. **Bed webs** in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. **For starting course on footings** where cells are not grouted, spread out full mortar bed, including areas under cells.

B. **Exterior Joints**:
   1. **Smooth/Standard Face** Masonry and **Honed** Face Masonry (if honed masonry is used): All **vertical** joints shall be **flush tooled**; All horizontal joints shall be **weather struck**.
   2. **Split face masonry** (if split face masonry is used): All joints shall be **flush tooled**.

C. **Interior Joints**:
   1. **Interior Smooth/Standard Face Masonry**: All joints **slightly concave** using a jointer larger than joint thickness.
   2. **Interior Honed** Face Masonry: All joints **raked**.

## 3.6 MASONRY-CELL INSULATION

A. **General**: Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer's instructions.

B. **Installation**: Fill all open cells and voids in hollow concrete masonry walls. The foam insulation shall be pressure injected through a series of 5/8" to 7/8" holes drilled into every vertical column of block cells (every 8" on center) beginning at an approximate height of four (4) feet from finished floor level. Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled. Patch holes with mortar and score to resemble adjacent surface.

## 3.7 MASONRY JOINT REINFORCEMENT

A. **General**: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. **Space reinforcement** not more than **16 inch**es (406 mm) o.c.
   2. **Space reinforcement** not more than **8 inches** (203 mm) o.c. in foundation walls and parapet walls.
   3. **Provide reinforcement** not more than **8 inches** (203 mm) above and below wall openings and extending **12 inches** (305 mm) beyond openings.
      a. **Reinforcement above** is **in addition to** continuous reinforcement.

B. **Cut or interrupt joint reinforcement** at control and expansion joints, unless otherwise indicated.

C. **Provide continuity at corners** and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

## 3.8 CONTROL AND EXPANSION JOINTS

A. **General**: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. **Form control joints in concrete masonry as follows**:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. **Build in horizontal, pressure-relieving joints** where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
   1. **Locate horizontal, pressure-relieving joints** beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

## 3.9 LINTELS

A. **Install steel lintels** where indicated.

B. **Provide minimum bearing of 8 inches** (200 mm) at each jamb, unless otherwise indicated.

## 3.10 FLASHING, WEEP HOLES, AND VENTS

A. **General**: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. **Prepare masonry surfaces** so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. **Install flashing as follows**:
   1. **At masonry-veneer walls,** extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches (200 mm), and behind air-infiltration barrier or building paper.
   2. **At lintels and shelf angles**, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn flashing up not less than 2 inches (50 mm) to form a pan.
   3. **Extend sheet metal flashing 1/2 inch** (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.

D. **Install weeps** in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
   1. Space weeps 32 inches (800 mm) o.c.

## 3.11 REINFORCED UNIT MASONRY INSTALLATION

A. **Temporary Formwork and Shores**: Construct formwork and shores to support reinforced masonry elements during construction.
   1. **Construct formwork** to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. **Do not remove forms** and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. **Placing Reinforcement**: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. **Grouting**: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
   1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

## 3.12 FIELD QUALITY CONTROL

A. **Owner will engage a qualified independent testing agency** to perform field quality-control testing indicated below.
   1. Payment for these services will be made by Owner.
   2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. **Testing Frequency**: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

C. **Mortar properties** will be tested per ASTM C 780. Test mortar for mortar air content, water-repellent admixture and compressive strength.

D. **Grout** will be sampled and tested for compressive strength per ASTM C 1019.

E. **Concrete Masonry Unit Tests**: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

## 3.13 REPAIRING, POINTING, AND CLEANING

A. **Remove and replace masonry units** that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. **Pointing**: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. **In-Progress Cleaning**: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. **Final Cleaning**: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. **Remove large mortar particles** by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. **Test cleaning methods** on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. **Protect adjacent stone and nonmasonry surfaces** from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   4. **Wet wall surfaces** with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
   5. **Clean brick by the bucket-and-brush hand-cleaning method** described in BIA Technical Notes No. 20, using job-mixed detergent solution.

## 3.14 MASONRY WASTE DISPOSAL

A. **Excess Masonry Waste**: Remove excess masonry waste and legally dispose of off Owner's property.

**END OF SECTION**

# SECTION 04 4300

# DIMENSION STONE CLADDING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** dimension stone in the following applications:
   1. Panels **mechanically anchored** on a metal grid system.
   2. **Trim units,** including copings, sills and jambs.

B. **Related Sections** include the following:
   1. **Division 5** Section "**Cold-Formed Metal Framing**" for steel studs supporting stone cladding.
   2. **Division 7** Section "**Water Repellents**" for water repellent/sealer applied to stone.
   3. **Division 7** Section "**Sheet Metal Flashing and Trim**" for exposed sheet metal flashing.

C. **Products installed, but not furnished**, in this Section include the following:
   1. **Steel lintels** and **shelf angles** for stone veneer assemblies specified in **Division 5** Section "**Metal Fabrications**."
   2. **Rigid cavity wall insulation** furnished under **Division 7** Section "**Building Insulation**."

### 1.3 DEFINITIONS

A. **Dimension Stone Cladding System**: An exterior wall covering system consisting of dimension stone panels and trim together with anchors, back-up structure, secondary weather barrier (sheathing), fluid applied air/moisture barrier, mortar, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.
   1. Back-up structure includes metal-grid system and miscellaneous steel framing required to secure stone to building structure.

### 1.4 PERFORMANCE REQUIREMENTS

A. **General:** Design stone anchors and anchoring systems according to ASTM C 1242.

B. **Structural Performance:** Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Wind Loads: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure as indicated on Structural Drawings.

C. **Seismic Performance:** Provide dimension stone cladding system capable of withstanding the effects of earthquake motions determined according to ASCE 7.
   1. Seismic Design Criteria: See Structural Drawings.

D. **Thermal Movements:** Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other deterimental 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. **Horizontal Building Movement (Interstory Drift):** Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.

F. **Shrinkage and Creep: A**llow for progressive vertical shortening of building frame equal to 1/8 inch in 10 feet (3 mm in 3 m).

G. **Safety Factors for Stone:** Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factor:
   1. Safety Factor for Quartz-Based Sandstone: 6.

H. **Design stone anchors and back-up structure to withstand loads indicated** without exceeding allowable working stresses as established by the following:
   1. For s**tructural steel**: AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design."
   2. For **cold-formed steel**: AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

I. **Limit deflection** in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to not more than 1/720 of assembly's clear span or the following, whichever is smaller:
   1. 1/16 inch (1.5 mm), measured in plane of wall.
   2. 1/4 inch (6 mm), measured perpendicular to wall.

J. **Provisions for Fabrication and Erection Tolerances:** Allow for fabrication and erection tolerances of building's structural system. Structural-steel fabrication and erection tolerances are specified in Division 5 Section "Structural Steel."

K. **Provisions for Deflection of Building Structure:** Allow for the following:
   1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4 inch (6 mm) vertical deflection in 20 feet (6 m) span of structural member supporting dimension stone cladding system.
   2. Live Load Deflection: Allow for 1/4 inch (6 mm) vertical deflection, in 20 foot (6 m) span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.

L. **Leakage Resistance, Water and Air:** Provide dimension stone cladding system that complies with the following:
   1. Air Infiltration: Not more than 0.004 cfm/sq. ft (0.02 L/s per sq. m) of wall area, as measured by testing mock-up per ASTM E283 at a differential pressure of 1.57 lbf/sq. ft. (75 Pa).
   2. Water Penetration: No uncontrolled water penetration beyond plane of back of dimension stone cladding system that is not contained or drained back to exterior, as measured by testing mock-up per ASTM E331 at a differential pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

M. **Control of Corrosion and Staining:** Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

## 1.5 SUBMITTALS

A. **Product Data**: For each type of product indicated.
   1. For stone varieties proposed for use on Project, include data on physical properties specified or required by referenced ASTM standards.

B. **Shop Drawings:** Show fabrication and installation details for dimension stone cladding system, including dimensions and profiles of stone units.
   1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
   2. Include details of sealant joints.
   3. Show locations and details of anchors and backup structure.
   4. Inlcude large-scale shaded elevations and details of decorative surfaces and inscriptions.
   5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineeer responsible for their preparation.

C. **Samples for Initial Selection:** For joint materials involving color selection.

D. **Stone Samples**: For each color, grade, finish, and variety of stone required, not less than 12 inches square.
   1. Sets shall consist of at least 5 samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.

E. **Sealant Samples for Verification**: For each type and color of joint sealant required.

F. **Welding Certificates.**

G. **Qualification Data:** For Installer, fabricator, professional engineer, and testing agency.

H. **Material Test Reports:** From a qualified testing agency, as follows:
   1. Stone Test Reports: For stone variety proposed for use on Project, provide test data indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
   2. For metal components, indicate chemical and physical properties of metal.
   3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements of Division 7 Section "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
   4. Preconstruction Sealant Field Test Report: From Installer, complying with requirements in Division 7 Section "Joint Sealants".

I. **Cold-Weather Procedures:** Detailed descriptions of methods, materials, and equipment to be used to comply with cold-weather requirements.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: An installer experienced in installing dimension stone cladding systems similar in material, design, and extent to those indicated for this Project and whose work has a record of successful in-service performance.

B. **Fabricator Qualifications:** Shop that employs skilled workers who custom-fabricate dimension stone cladding systems similar to that required for this Project and whose products have a record of success in-service performance.
   1. Fabricator's responsibilities include fabricating dimension stone cladding and providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Comprehensive engineering analysis by a qualified professional engineer.

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

D. **Source Limitations for Stone:** Obtain stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
   1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
   2. Make quarried blocks available for examination by Architect for appearance characteristics.

E. **Source Limitations for Other Materials**: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.

F. **Preconstruction Stone Testing:** Engage a qualified independent testing agency to perform preconstruction testing indicated below.
   1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   2. Furnish test specimens that are representative of materials proposed for incorporation into the Work.

3. Physical Property Tests: For stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
4. Flexural Strength Tests: For stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested, according to ASTM C880, in both wet and dry conditions.
5. Anchorage Tests: For stone variety, orientation of cut, finish and anchor type proposed for use on Project, tested according to ASTM C 1354.
6. Anchoring System Mock-up Tests: For performance of dimension stone cladding system, evaluated for compliance with requirements of mockup testing per ASTM C1201, Procedure B, with a maximum test load equal to 3 times the design load.
7. Cladding System Mock-up Tests: For performance of dimension stone cladding system corresponding to area indicated on Drawings. Build test mock-ups at testing agencies facilities from same materials proposed for Project, using installers who will perform same tasks for Project.
8. Testing agency will report test results in writing to Architect and Contractor.

G. **Preconstruction Sealant Compatibility and Adhesion Testing:** Submit to joint sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Division 7 Section "Joint Sealants," samples of ma teirals that will contact or affect joint sealants.

H. **Preconstruction Field Testing of Sealants**: Before installing joint sealants, field test their adhesion to joint substrates per requirements specified in Division 7 "Joint Sealants".

I. **Welding:** Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel"; AWS D1.3, "Structure Welding Code - Sheet Steel."

J. **Mockups**: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
1. **Build mock-up of typical wall area** as shown on Drawings.
2. **Protect accepted mockups** from the elements with weather-resistant membrane.
3. **Approval of mockups** 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.
   a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. **Approved mockups may become part of the completed Work** if undisturbed at time of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Store and handle stone** and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, or other causes.
1. **Lift stone with wide-belt slings**; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. **Store stone on wood skids or pallets** with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. **Mark stone units**, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. **Deliver sealants to Project site in original unopened containers** labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

## 1.8 PROJECT CONDITIONS

A. **Protection of Dimension Stone Cladding**: 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 (600 mm) down both sides and hold cover securely in place.

B. **Stain Prevention**: Immediately remove mortar and soil to prevent them from staining the face of dimension stone cladding.
   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 dimension stone cladding.

C. **Cold-Weather Requirements**: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions.
   1. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   2. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection for 48 hours after construction:
      a. 40 to 25 deg F (Plus 5 to minus 4 deg C): Cover dimension stone cladding with a weather-resistant membrane.
      b. 25 to 20 deg F (Minus 4 to minus 7 deg C): Cover dimension stone cladding with weather-resistant, insulating blankets or provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure. Use windbreaks or enclosures when wind velocity exceeds 15 mph (25 km/h).
      c. 20 deg F (Minus 7 deg C) and below: Provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure.

D. **Hot-Weather Requirements**: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

E. **Environmental Limitations for Sealants:** Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joints substrates are wet.

## 1.9 COORDINATION

A. **Coordinate installation of inserts** that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing dimension stone cladding system. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. **Time delivery and installation of dimension stone cladding** to avoid extended on-site storage and to coordinate with work adjacent to dimension stone cladding.

## 1.10 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. Dimension Stone Units: **Furnish two finished stone panels** for each size used for each finish and variety of stone specified.

# PART 2 - PRODUCTS

## 2.1 QUARTZ-BASED STONE (SANDSTONE)

A. **Quartz-Based Stone:** Comply with ASTM C616, Classification I Sandstone or II Quartzitic Sandstone.

B. **Varieties and Sources:** Subject to compliance with requirements of the Contract Documents, provide the following stone. Other stones and suppliers may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect. Other stones shall be submitted as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections:
   1. **Supplier:** Delta Stone Products, Inc.
   2. **Stone:** Arches Red.

C. **Finish:** Smooth cut and sand blasted.
   1. **Match Architect's samples** for color, finish, and other stone characteristics relating to aesthetic effects.

D. **Corners:** "L" cut or pistol cut as shown on Drawings.

E. **Thickness:** For wall panels, not less than 5 cm (2 inches nomimal), unless otherwise indicated. Panel size to be 18 x 36 inches and as shown on Drawings.

F. **Sandstone Caps:** Not less than 3 inches. Panel lengths as shown for radius application.

## 2.2 ANCHORS AND FASTENERS

A. **Fabricate anchors**, including shelf angles, from **stainless steel**, ASTM A666, Type 304, temper as required to support loads imposed without exceeding allowable design stresses**. Fabricate dowels and pins** for anchors from **stainless steel**, ASTM A276, Type 304.

B. **Threaded Fasteners:** Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.
   1. For stainless steel, use annealed stainless steel bolts, nuts and washers; ASTM F 593 (ASTM F738M) for bolts; and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).
   2. For backup structure, use carbon steel bolts, nuts, and washers; ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), for bolts; ASTM A 563 (ASTM A 563M), Grade A, for nuts; and ASTM F 436 (ASTM F 436M) for washers; all hot-dip or mechanically zinc coated.
   3. **All supports, anchors, angles, and fasteners in contact with stone must be Type 304 stainless steel.**

## 2.3 FRAMING FOR BACKUP STRUCTURE

A. **Metal-Grid Systems**: Provide manufacturer's standard integrated system that combines metal struts, fittings, fasteners, and stone anchors and that is engineered expressly for mechanicaly installing dimension stone cladding and that complies with the following requirements:
   1. **Available Products:** Subject to compliance with requirements of Contract Documents, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Canaren Inc.; **A-Metal** System.
      b. Georgia Marble Company; **Zibell** Anchoring System.
      c. Hohmann & Barnard, Inc.; **HB Stone Support** System.
      d. Meadow Burke; **Halfen** Anchoring System.
   2. **Struts**: Cold-formed metal channels with continuous slot complying with MFMA-3, of size and shape required for application indicated, made from galvanized steel complying with ASTM A 653/A 653M, with G90 (Z275) coating, and not less than 0.108 inch (2.74 mm) nominal thickness.
   3. **Fittings and Fastenings**: System manufacturer's standard components of design, size, and material required to securely attach struts to building structure, by method indicated or selected, and stone anchors to struts, as well as to prevent galvanic corrosion. Fabricate components in contact with stone from same material specified for anchors.
   4. **Stone Anchors**: Shapes and sizes standard with system manufacturer, complying with "Anchors and Fasteners" Article.

## 2.4 STONE ACCESSORIES

A. **Concealed Stone Metal Flashing:** Fabricate from stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick.

B. **Plastic Weep Hole/Vents**: One-piece, flexible extrusion manufactured from UV-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, in color selected from manufacturer's standards.

C. **Sealants for Joints in Dimension Stone Cladding**: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with Division 7 Section "Joint Sealants" and do not stain stone.
   1. Single-component, nonsag, urethane sealant.
   2. Colors: Provide colors of exposed sealants to comply with the following requirement:
      a. Provide color as selected by Architect from manufacturer's full range.

D. **Sealant for Filling Kerfs**: Same sealant used for joints in dimension stone.
   1. Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry).
   2. **Available Products:** Subject to compliance with requirements of Contract Documents, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Sika Corporation, Inc.; Sikaflex - 1a.
      b. Sonneborn, Division of ChemRex; NP 1.
      c. Sonneborn, Division of ChemRex; Ultra.
      d. Tremco, Sealant/Waterproofing Division; Vulkem 116.

E. **Setting Shims:** Strips of resilient plastic or vulcanized neoprene, Type A shore duromeer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

## 2.5 STONE FABRICATION

A. **General**: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

B. **Control depth of stone and back check** to maintain minimum clearance of 1 inch (25 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

C. **Dress joints (bed and vertical) straight and at right angles** to face, unless otherwise indicated. Shape beds to fit supports.

D. **Cut and drill sinkages and holes** in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

E. **Finish exposed faces and edges of stone** to comply with requirements indicated for finish and to match approved samples.

F. **Quirk-miter corners**, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.

G. **Cut stone to produce uniform joints 3/8 inch (10 mm) wide** and in locations indicated.

H. **Fabricate molded work**, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

I. **Contiguous Work**: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

J. **Clean backs of stone** to remove rust stains, iron particles, and stone dust.

K. **Inspect finished stone units at fabrication plant** for compliance with requirements for appearance, material, and fabrication. Replace defective units.
   1. **Grade and mark stone** for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mock-ups.

## 2.6 SOURCE QUALITY CONTROL

A. **Source Quality-Control Testing Service:** Engage a qualified independent testing agency to perform source quality-control testing as indicated below.
   1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   2. Furnish test specimens selected by testing agency from same blocks as actual materials proposed for incorporation into the Work.
   3. Flexural Strength Tests: ASTM C880, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every 5000 sq. ft. (500 sq. m), but not fewer than 2 sets.

B. Testing agency will **report test results** in writing **to Architect and Contracto**r.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. **Compressible Filler**: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine surfaces** indicated to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLING BACK-UP STRUCTURE

A. **Installing Metal-Grid Systems:** Comply with manufacturer's written instructions to provide integrated system that combines metal struts, fittings, fasteners, and stone anchors.
   1. Fasten struts by bolting to steel angle clips bolted to steel framing.
   2. Fasten stone supports and anchors by bolting to struts.
   3. Shim and adjust struts and stone supports and anchors to provide grid that is level, plumb, and true to line with no variation in plane or alignment exceeding 1/16 inch (1.5mm) and no variation in position exceeding 1/8 inch (3 mm).

## 3.3 SETTING DIMENSION STONE CLADDING, GENERAL

A. Before setting stone, **clean dirty or stained stone surfaces** by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. **Execute dimension stone cladding installation by skilled mechanics** and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
   1. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

C. **Contiguous Work:** Provide reveals, reglets, and openings as required to accommodate contiguous work.

D. **Set stone to comply with requirements indicated** on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

E. **Stone Pattern:** 1/3 offset running bond.

F. **Provide expansion, control, and pressure-relieving joints** of widths and at locations indicated.
   1. Keep expansion and pressure-relieving joints free of mortar and other rigid materials.
   2. Sealing expansion, control, and pressure-relieving joints is specified in Division 7 Section "Joint Sealants."

G. I**nstall concealed flashing** at continuous shelf angles, lintels, ledges, base and similar obstructions to downward flow of water to divert water to building exterior.

H. **Keep cavities open** where unfilled space is indicated between back of stone units and back-u wall; do not fill cavities.
   1. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm). Use plastic weep hole/vents.
   2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally. Use plastic weep hole/vents.

## 3.4 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

A. **Attach anchors securely** to stone and into metal stud surfaces supporting sheathing. Comply with recommendations of ASTM C1242.

B. **Provide compressible filler** in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.

C. **Set stone supported on clips** or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

## 3.5 JOINT SEALANT INSTALLATION

A. **Prepare joints and apply sealants** of type and at locations indicated to comply with applicable requirements of Division 7 Section "Joint Sealants".

## 3.6 CONSTRUCTION TOLERANCES

A. **Variation from Plumb:** For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

B. **Variation from Level**: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m) or 3/8 inch (10 mm) maximum.

C. **Variation from Linear Building Line:** For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. **Variation in Cross-Sectional Dimensions:** For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).

E. **Variation in Joint Width:** Do not vary from average joint wide more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. **Variation in Plane between Adjacent Stone Units (Lipping):** Do not exceed 1/16 inch (1.5 mm) difference between planes of adjacent units.

## 3.7 FIELD QUALITY CONTROL

A. **Field Quality-Control Water Leakage Test**: Test dimension stone cladding system according to AAMA 501.2.
   1. Notify Architect 7 days in advance of dates and times when testing will be done.
   2. Perform test at 3 locations as directed by Architect.
   3. Report test results in writing to Architect and Owner.

## 3.8 ADJUSTING AND CLEANING

A. **Remove and replace dimension stone cladding** of the following description:
   1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
   2. Defective joints.
   3. Dimension stone veneer cladding that does not matching approved samples and mockups.
   4. Stone veneer assemblies not complying with other requirements indicated.

B. **Replace in a manner that results in** dimension stone cladding's **matching approved samples and mockups**, complying with other requirements, and showing no evidence of replacement.

C. **In-Progress Cleaning**: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

D. **Final Cleaning:** Clean dimension stone cladding no fewer than 6 days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

**END OF SECTION**

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# DIVISION 5 - METALS


| | |
|---|---|
| Section 05 1200 | Structural Steel |
| Section 05 2100 | Steel Joists |
| Section 05 3100 | Steel Deck |
| Section 05 4200 | Cold-Formed Metal Framing |
| Section 05 5000 | Metal Fabrications |
| Section 05 5240 | Wire Cable Railing |
| Section 05 5900 | Architectural Joint Systems |
| Section 05 7323 | Glass Railings |

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# SECTION 05 1200

# STRUCTURAL STEEL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Extent of structural steel work is shown on Drawings**, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

B. **Related Sections:**
1. **Division 5** Section "**Steel Decking**" for field installation of shear connectors through deck.
2. **Division 5** Section "**Metal Fabrications**" for miscellaneous steel fabrications and other metal items not defined as structural steel.

C. **Definitions:**
1. **Structural Steel**: Elements of structural-steel frame, as classified by American Institute of Steel Construction (AISC) 303, "Code of Standard Practice for Steel Buildings and Bridges" and as otherwise shown on drawings.
2. **Seismic-Load-Resisting System**: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
3. **Heavy Sections**: Rolled and built-up sections as follows:
   a. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
   b. Welded built-up members with plates thicker than 2 inches (50 mm).
   c. Column base plates thicker than 2 inches (50 mm).
4. **Protected Zone**: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
5. **Demand Critical Welds**: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings

### 1.3 SUBMITTALS

A. **Product Data**: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. High-strength bolts (each type), including nuts and washers.
2. Structural steel primer paint.
3. Shrinkage-resistant grout.

B. **Shop Drawings**: Submit shop drawings, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.
   1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.
      a. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of others sections.

C. **Test Reports**: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

D. **Surveys**: Submit certified copies of each survey conducted by a registered professional engineer, showing elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and Contract Documents.

## 1.4 QUALITY ASSURANCE

A. **Source Quality Control:** Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
   1. Promptly remove and replace materials or fabricated components which do not comply.

B. **Fabricator Qualifications**: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
   1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
      a. Category: Category Cbd, complex steel building structures.
   2. Fabricators without AISC Certification shall provide special inspectors and conduct special inspections as required by authorities having jurisdiction.
   3. Other Certifications, other than AISC, may be acceptable but must be submitted and approved by authorities having jurisdiction prior to fabrication of any steel.

C. **Design of Members and Connections**: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

D. **Promptly notify Architect** whenever design of members and connections for any portion of structure are not clearly indicated.

E. **Codes and Standards:**
   1. **Comply** with provisions of following, except as otherwise indicated:
      a. **AISC 303 - 2005** "Code of Standard Practice for Steel Buildings and Bridges", excluding the following: Section 1.5.2, Section 3.3 (last sentence of paragraph), Section 4.4, Section 4.4.1, Section 4.4.2, Section 4.5, Section 7.5.4, and Section 7.11.5, and Section 7.13.3.

2. **AISC 360 - 2010** "Specification for Structural Steel Buildings", including "Commentary" and Supplements thereto as issued.
3. **AISC 341 - 2010** "Seismic Provisions of Structural Steel Buildings"
4. **AISC/RCSC 2004** "Specification for Structural Joints using ASTM A325 or A490 Bolts" prepared by the Research Council on Structural Connections.
5. **American Welding Society** (AWS) **D1.1 - 2010** "Structural Welding Code - Steel".
6. **ASTM A 6** "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

F. **Qualifications for Welding Work:** Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the last 12 months.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

G. **Pre-Demolition Meeting (Existing Arena Roof)**: Prior to beginning any structural demolition on the existing arena roof, the Contractor shall schedule and host on-site a pre-construction/pre-design meeting to discuss the intent of the roof bracing required in the Structural Drawings as it pertains to the Contractor's schedule and sequencing.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. **Deliver materials to site** at such intervals to ensure uninterrupted progress of work.
1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

B. **Store materials to permit easy access** for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. **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

## 1.6 COORDINATION

A. **Coordinate selection of shop primers** with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another. Note requirements for intumescent and other fireproofing coatings, in particular.

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

## 1.7 CASH ALLOWANCE

A. Contractor shall include a **cash allowance of $10,000.00** for purchase, detailing, fabrication and erection of structural steel beyond that which is required by the Contract Documents.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

A. **Metal Surfaces, General:** For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. **Wide Flange Structural Steel Shapes**: ASTM A 992, Grade 50 enhanced.
   1. Other Structural Steel Shapes, Plates and Bars: ASTM A 36, unless noted otherwise on the Structural Drawings.

C. **Hollow Structural Sections (HSS)**: ASTM A 500, Grade B.

D. **Hot-Formed Steel Tubing:** ASTM A 501.
   1. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.
      a. Finish: Black, except where indicated to be galvanized.

E. **Steel Castings**: ASTM A 27, Grade 65-35, medium-strength carbon steel.

F. **Anchor Bolts:** ASTM A 307, headed type unless otherwise indicated.

G. **Unfinished Threaded Fasteners:** ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
   1. Provide either hexagonal or square, heads and nuts, except use only hexagonal units for exposed connections.

H. **High-Strength Threaded Fasteners:** Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
   1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325.
   2. Direct tension indicator washers may be used at Contractor's option.

I. **Electrodes for Welding:** Comply with AWS requirements.

J. **Structural Steel Primer Paint:** SSPC - Paint 13. Interior structural steel to receive application of spray-applied fireproofing or intumescent coatings shall be free of primer and paint coatings.

K. **Cement Grout:** Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

L. **Nonmetallic, Shrinkage-Resistant Grout:** ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

1. **Acceptable Manufacturers:** Subject to compliance with requirements of Contract Documents, provide one of the following products. If not listed, submit as a substitution according to the Conditions of the Contract and Division 1 Sections.
   a. NS Grout; **Euclid** Chemical Co.; www.euclidchemical.com
   b. Masterflow 713; **BASF** Corporation; www.buildingsystems.basf.com
   c. Five Star Grout; **Five Star** Products, Inc.; www.fivestarproducts.com

## 2.2 FABRICATION

A. **Shop Fabrication and Assembly**: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
3. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   a. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
4. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

B. **Connections:** Weld or bolt shop connections, as indicated.

1. Bolt field connections, except where welded connections or other connections are indicated.
   a. Joint Type: Snug tightened unless indicated otherwise on Drawings.
2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
3. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

C. **High-Strength Bolted Construction**: Install high-strength threaded fasteners in accordance with AISC/RCSC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts".

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

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

E. **Shear Connectors:** Prepare steel surfaces as recommended by manufacturer of shear connectors. Where possible shop weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

## 2.3 SHOP PAINTING

A. **General:** Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar or to receive application of spray applied fireproofing or intumescent coating. Paint embedded steel which is partially exposed on exposed portions and initial 2 inches of embedded areas only.

B. **Non-painted Areas:** Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.

C. **Inaccessible Surfaces:** Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. **Surface Preparation:** After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
1. SP-1 "Solvent Cleaning".
2. At all exposed exterior steel and exposed interior steel prepare surface in accordance with commercial blast cleaning SSPC-SP6 with median surface profile of 1.5 to 2.0 mils.

E. **Painting:** Provide a one-coat shop applied paint system complying with Steel Structures Painting Council (SSPC)-Paint System Guide No. 7.00. Refer to Section 09 9000, "Painting", for specific primer required on identified steel items.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. **Surveys:** Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.

## 3.2 ERECTION

A. **Temporary Shoring and Bracing:** Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Do not shore cambered steel beams unless otherwise indicated on drawings.
   1. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
   2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

B. **Setting Bases and Bearing Plates:** Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
   1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

C. **Adjustments:** Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout. Install high strength washers under nuts at all anchor bolts.

D. **Grouting:** Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
   1. Comply with manufacturer's instructions.

E. **Field Assembly:** Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure within specified AISC tolerances.
   2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
   3. Splice members only where indicated and accepted on shop drawings.

F. **Erection Bolts:** On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

G. **Field Adjustments:** Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
   1. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

H. **Thermal Cutting:** Do not use thermal cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

I. **Touch-Up Painting:** Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
   1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

## 3.3 QUALITY CONTROL

A. **Testing Agency:** Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section.

B. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

C. **Provide access for testing agency** to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

D. **Testing agency may inspect structural steel at plant** before shipment; however, Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

E. **Correct deficiencies** in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

F. **Shop Bolted Connections**: Inspect or test in accordance with AISC specifications.

G. **Shop Welding:** Inspect and test during fabrication of structural steel assemblies, as follows:
   1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Perform visual inspection of all welds.
   3. Perform tests of welds as follows. Inspection procedures listed are to be used at Contractor's option.
      a. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
      b. Ultrasonic Inspection: ASTM E 164.
   4. Inspection of shop welding is not required if the fabricator complies with Section 1704.2.2 of the 2009 IBC.

H. **Field Bolted Connections:** Inspect in accordance with 2009 IBC Section 1704.3.3 per AISC 360 "Specification for Structural Steel Buildings".

I. **Field Welding**: Inspect and test during erection of structural steel as follows:
   1. Comply with 2009 IBC Section 1704.1 and Table 1704.3.
   2. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   3. Perform visual inspection of all welds.

## 3.4 CLEANUP

A. Refer to Division 1 Section "Execution Requirements".

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# SECTION 05 2100

# STEEL JOISTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section include**s the following:
1. **Open-web K-series** steel joists.
2. **LH-series long-span** steel joists.
3. Joist **accessories**.

B. **Related Sections** include the following:
1. **Division 4** Section "**Unit Masonry Assemblies**" for installing bearing plates in unit masonry.
2. **Division 5** Section "**Structural Steel**" for field-welded shear connections.
3. **Division 5** Section "**Metal Fabrications**" for furnishing steel bearing plates.

### 1.3 DEFINITIONS

A. **SJI "Specifications":** Steel Joist Institute's "**Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders**."

B. **Special Joists**: Joists requiring modification by the manufacturer to support non-uniform, unequal, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

### 1.4 PERFORMANCE REQUIREMENTS

A. **Structural Performance**: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated.

B. **Design joists** to withstand design loads with total load deflections no greater than the following:
1. **Roof Joists**: Vertical deflection **as indicated on the Structural Drawings**.
2. **Floor Joists**: Vertical deflection **as indicated on the Structural Drawings**.

### 1.5 SUBMITTALS

A. **Product Data**: For each type of joist, accessory, and product indicated.

B. **Shop Drawings**: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
   1. **Indicate locations and details of anchorage devices** and bearing plates to be embedded in other construction.
   2. **Comprehensive engineering analysis** of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

C. **Welding Certificates**: Copies of certificates for welding procedures and personnel.

D. **Mill Certificates**: Provide mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

## 1.6 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
   1. **Manufacturer must be certified by SJI** to manufacture joists complying with SJI standard specifications and load tables.
   2. **Manufacturer assumes responsibility for engineering special joists** to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
   3. **Professional Engineer Qualifications**: A professional engineer who is legally authorized 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 joists that are similar to those indicated for this Project in material, design, and extent.

B. **SJI Specifications**: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

C. **Welding**: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver, store, and handle joists** as recommended in SJI's "Specifications."

B. **Protect joists from corrosion, deformation, and other damage** during delivery, storage, and handling.

## 1.8 SEQUENCING

A. **Deliver steel bearing plates** and other devices to be built into concrete and masonry construction.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. **Steel**: Comply with SJI's "Specifications" for chord and web members.

B. **Steel Bearing Plates**: ASTM A 36/A 36M.

C. **Carbon-Steel Bolts and Threaded Fasteners**: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
   1. **Finish:** Plain, uncoated.

D. **High-Strength Bolts and Nuts**: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
   1. **Finish**: Plain, uncoated.

E. **Welding Electrodes**: Comply with AWS standards.

F. **Galvanizing Repair Paint**: SSPC-Paint 20 or DOD-P-21035.

### 2.2 PRIMERS

A. **Primer**: Gray or white, fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements in FS TT-P-664.

### 2.3 OPEN-WEB K-SERIES STEEL JOISTS

A. **General**: Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.
   1. **Joist Type**: **K-series** steel joists.

B. **Welding**: Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. **Connections**: Provide holes in chord members for connecting and securing other construction to joists.

D. **Top-Chord Extensions**: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. **Extended Ends**: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. **Camber**: Camber joists according to SJI's "Specifications."

G. **Bearing Ends**: Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

## 2.4 LONG-SPAN STEEL JOISTS

A. **Manufacture steel joists** according to "**Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series**," in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:
   1. **Joist Type**: LH-series steel joists and DLH-series steel joists.
   2. **End Arrangement**: Underslung.
   3. **Top-Chord Arrangement**: Parallel chord.

B. **Comply with AWS** requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. **Provide holes in chord members** for connecting and securing other construction to joists.

D. **Camber long-span steel joists** according to SJI's "Specifications."

E. **Equip bearing ends** of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

## 2.5 JOIST ACCESSORIES

A. **Bridging**: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
   1. Furnish additional erection bridging if required.

B. **Bearing Plates**: Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

C. **Ceiling Extensions**: Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

D. **Miscellaneous Accessories**: Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

## 2.6 CLEANING AND SHOP PAINTING

A. **Clean and remove loose scale**, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by power-tool cleaning, SSPC-SP 3.

B. **Apply one shop coat of primer** to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.
   1. **Refer to Division 9, Section** - **Painting**, for specific primer required on identified steel items.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine supporting substrates**, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. **Proceed with installation** only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. **Do not install joists** until supporting construction is in place and secured.

B. **Install joists and accessories plumb, square, and true to line**; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
   3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
   4. Do not rigidly connect bottom chords to columns.

C. **Field weld joists to supporting steel bearing plates**. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. **Bolt joists to supporting steel framework** using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. **Install and connect temporary bridging** concurrently with joist erection, before construction loads are applied.
   1. **Bridging** shall be designed and erected **as required to not interfere with mechanical ductwork** that occurs between and parallel to joists. Coordinate with the Architectural, Mechanical, and Structural Drawings.

### 3.3 FIELD QUALITY CONTROL

A. **Testing Agency**: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. **Field welds** will be visually inspected according to AWS D1.1.

C. **In addition to visual inspection**, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:
   1. **Radiographic Testing**: ASTM E 94 and ASTM E 142.
   2. **Magnetic Particle Inspection:** ASTM E 709.
   3. **Ultrasonic Testing**: ASTM E 164.
   4. **Liquid Penetrant Inspection:** ASTM E 165.

D. **Bolted connections** will be visually inspected.
   1. **High-strength, field-bolted connections** will be tested and verified according to procedures in RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

E. **Correct deficiencies** in Work that inspections and test reports have indicated are not in compliance with specified requirements.

F. **Additional testing** will be performed to determine compliance of corrected Work with specified requirements.

## 3.4 REPAIRS AND PROTECTION

A. **Touchup Painting**: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
   1. Clean and prepare surfaces by power-tool cleaning, SSPC-SP 3.
   2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

B. **Provide final protection** and maintain conditions in a manner acceptable to manufacturer and Installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

# SECTION 05 3100

# STEEL DECK

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
1. **Roof** deck.
2. **Composite floor** deck.
3. **Method of attachment to structure** shall be as approved by Architect and Structural Engineer.

B. **Related Sections** include the following:
1. **Division 3** Section **"Cast-in-Place Concrete**" for concrete fill and reinforcing steel over steel deck.
2. **Division 5** Section "**Structural Steel**" for shop- and field-welded shear connectors.
3. **Division 5** Section "**Metal Fabrications**" for framing deck openings with miscellaneous steel shapes.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of deck, accessory, and product indicated.

B. **Shop Drawings**: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction. Method of attachment to structure shall be described.

C. **Product Certificates**: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

D. **Welding Certificates**: Copies of certificates for welding procedures and personnel.

E. **Product Test Reports**: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
1. Mechanical fasteners.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Welding**: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. **Fire-Test-Response Characteristics**: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.
   1. **Fire-Resistance Ratings**: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
   2. **Markings**: Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. **AISI Specifications**: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. **FM Listing**: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

F. **Supply deck free of lubricants or oils which would impair the adhesion of the spray-applied fireproofing or intumescent coating**. The deck manufacturer shall certify that the painted steel deck is UL classified and has been fire tested with the appropriate fireproofing material.

## 1.5 PRE-INSTALLATION MEETING

A. Installer shall demonstrate workmanship by conducting representative fastenings and welds at pre-installation meeting subject to guidance from mechanical fastener manufacturer and approval of the Structural Engineer.

B. Mechanical fastener manufacturer's direct representative shall instruct installer and inspector on proper evaluation of installed fasteners.

C. In areas where underside of deck will be exposed to view, written approval of the Architect is required.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Protect steel deck** from corrosion, deformation, and other damage during delivery, storage and handling.

B. **Stack steel deck** on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. **Steel Deck**:
   a. **ASC Profiles**, Inc.; a Blue Scope Steel company
   b. **Canam** Steel Corp.
   c. **Consolidated** Systems, Inc.
   d. **Nucor** Corp.; Vulcraft Div.
   e. **Roof Deck**, Inc.
   f. **Verco** Manufacturing Co.
   g. **Wheeling** Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

### 2.2 ROOF DECK

A. **Steel Roof Deck**: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following:

1. **Prime-Painted Steel Sheet**: ASTM A 611, **Grade C** minimum, shop primed with white or gray baked-on, lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.
2. **Deck Profile**: **Type B** as indicated **on the Structural Drawings.**
3. **Profile Depth**: 1 1/2 inches **as indicated on the Structural Drawings**.
4. **Design Uncoated-Steel Thickness**: Per plan.
5. **Span Condition**: Triple span or more as indicated.
6. **Side Laps**: As indicated on the Structural Drawings.

### 2.3 COMPOSITE FLOOR DECK

A. **Composite Steel 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, the minimum section properties indicated, and the following:

1. **Galvanized and Shop-Primed Steel Sheet**: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; with unpainted top and bottom surface cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664
2. **Deck Profile**: As indicated on the Structural Drawings.
3. **Profile Depth:** As indicated on the Structural Drawings.
4. **Design Uncoated-Steel Thickness**: As indicated on the Structural Drawings.
5. **Span Condition**: Triple span or more as indicated on the Structural Drawings.
6. **Provide vented deck** where required by floor finish/traffic coating system.

### 2.4 ACCESSORIES

A. **General**: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. **Mechanical Fasteners**: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. **Side-Lap Fasteners:** As indicated on the Structural Drawings.

D. **Rib Closure Strips**: Vulcanized, closed-cell, synthetic rubber.

E. **Miscellaneous Sheet Metal Deck Accessories**: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. **Pour Stops and Girder Fillers**: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 29 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. **Weld Washers:** Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

I. **Recessed Sump Pans**: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2- inch (38-mm) minimum depth. For drains, cut holes in the field.

J. **Shear Connectors**: ASTM A 108, Grades 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B, with arc shields.

K. **Galvanizing Repair Paint**: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight

L. **Repair Paint**: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

## 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.

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 decking 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.

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 decking.

G. **Provide additional reinforcement** and closure pieces at openings as required for strength, continuity of decking, 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 in locations accepted and approved by the Architect. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

## 3.3 ROOF DECK INSTALLATION

A. **General**: Roof deck shall be tight to supporting steel framing. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches (38 mm) long, and as follows unless otherwise indicated on structural drawings:
   1. **Weld Diameter**: 3/4 inch (19 mm), nominal.
   2. **Weld Spacing**: Weld edge and interior ribs at locations and spacings as indicated on the drawings.

B. **Mechanical fasteners** may be used in lieu of welding to fasten deck in locations accepted and approved by the Architect and the Structural Engineer. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

C. **Side-Lap and Perimeter Edge Fastening**: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated on the Structural Drawings.

D. **End Bearing**: Install deck ends over supporting frame with a minimum end bearing of 1 1/2 inches (38 mm), with end joints as follows:
   1. **End Joints**: Lapped **2 inches** (51 mm) minimum.

E. **Roof Sump Pans and Sump Plates**: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least 1 weld at each corner.

F. **Miscellaneous Roof Deck Accessories**: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

G. **Flexible Closure Strips**: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

## 3.4 FLOOR DECK INSTALLATION

A. **Fasten floor deck panels** to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. **Weld Diameter**: 3/4 inch (19 mm), nominal.
   2. **Weld Spacing**: Weld edge ribs of panels at each support. Space additional welds at 12 inches (305 mm) apart.
   3. **Weld Spacing**: Space and locate welds as indicated or as recommended by manufacturer.

B. **Side-Lap and Perimeter Edge Fastening**: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (910 mm), and as follows.
   1. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws or fasten with a button punch.

C. **End Bearing**: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows.
   1. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws or fasten with a button punch.

D. **Shear Connectors**: Weld shear connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Butt end joints of deck panels; do not overlap. Remove and discard arc shields after welding shear connectors.

E. **Pour Stops and Girder Fillers**: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

F. **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 decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

## 3.5 FIELD QUALITY CONTROL

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

B. **Field welds** will be subject to inspection. Examination and qualification of puddle welds and fillet welds shall be in accordance with AWS D1.3 criteria. Ensure deck is clamped to the supporting steel framing.

C. **Mechanical Fasteners:** Examine fastener placement location and washer condition. Ensure steel deck is tight and clamped to the supporting steel framing.

D. **Shear connector stud welds** will be inspected and tested according to AWS D1.1 for stud welding and as follows:
   1. Shear connector stud welds will be visually inspected.
   2. Bend tests will be performed if visual inspections reveal less than a full 360-degree flash or welding repairs to any shear connector stud.
   3. Tests will be conducted on additional shear connector studs if weld fracture occurs on shear connector studs already tested according to AWS D1.1.

E. **Testing agency** will report test results promptly and in writing to Contractor and Architect.

F. **Remove and replace work** that does not comply with specified requirements.

G. **Additional testing and inspecting,** at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

## 3.6 REPAIRS AND PROTECTION

A. **Galvanizing Repairs**: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

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.

C. **Provide final protection** and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

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## SECTION 05 4200

## COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Exterior non-load-bearing** wall framing.
   2. **Sill sealer** for exterior steel stud walls

B. **Related Sections** include the following:
   1. **Division 5** Section "**Metal Fabrications**" for masonry shelf angles and connections.
   2. **Division 9** Section "**Non-Load-Bearing Steel Framing**" for interior non-load-bearing metal-stud framing and ceiling-suspension assemblies.

### 1.3 DEFINITIONS

A. **Minimum Un-coated Steel Thickness**: Minimum un-coated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. **Producer**: Entity that produces steel sheet coil fabricated into cold-formed members.

### 1.4 PERFORMANCE REQUIREMENTS

A. **Structural Performance**: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. **Design Loads**: As indicated.
   2. **Deflection Limits**: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Curtain-Wall Framing: Horizontal deflection of 1/240 of the wall height.
   3. **Design framing systems to provide for movement** of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
   4. **Design framing system to maintain clearances** at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.

B. **Design exterior non-load-bearing curtain-wall framing** to accommodate horizontal deflection without regard for contribution of sheathing materials.

## 1.5 SUBMITTALS

A. **Product Data**: For each type of cold-formed metal framing product and accessory indicated.

B. **Shop Drawings**: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.

C. **Product Test Reports**: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
   1. Expansion anchors.
   2. Power-actuated anchors.
   3. Mechanical fasteners.
   4. Vertical deflection clips.
   5. Miscellaneous structural clips and accessories.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Welding**: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. **Fire-Test-Response Characteristics**: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. **Fire-Resistance Ratings**: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

D. **AISI Specifications**: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Protect cold-formed metal framing** from corrosion, deformation, and other damage during delivery, storage, and handling.

B. **Store cold-formed metal framing,** protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
1. **Studco Building Systems**, Inc.
2. **CEMCO** (California Expanded Metal Products Co.)
3. **ClarkDietrich Industries**, Inc.
4. **SCAFCO** Corp.

### 2.2 MATERIALS

A. **Steel Sheet**: ASTM A 570/A 570M, hot rolled or ASTM A 611, cold rolled; cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free, rust-inhibitive primer complying with performance requirements in FS TT-P-664, of grade as indicated on the Structural Drawings.

### 2.3 NON-LOAD-BEARING WALL FRAMING

A. **Steel Studs**: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows unless otherwise indicated on the structural drawings:
1. **Minimum Uncoated-Steel Thickness**: **16 gauge** (1.72 mm).
2. **Flange Width**: 1-5/8 inches (41 mm).

B. **Steel Track**: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM C 955, and as follows unless otherwise indicated on the structural drawings:
1. **Minimum Uncoated-Steel Thickness**: Match steel studs.
2. **Flange Width**: 1-1/4 inches (32 mm).

C. **Vertical Deflection Clips**: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure.

### 2.4 FRAMING ACCESSORIES

A. **Fabricate steel-framing accessories** of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa).

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. End clips.
5. Foundation clips.
6. Gusset plates.
7. Stud kickers, knee braces, and girts.
8. Hole reinforcing plates.
9. Backer plates.

## 2.5 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.
   1. Where indicated on Drawings, provide "Z" clips with center section equal to the depth of exterior cavity insulation. Clips shall be attached through sheathing to metal stud framing system behind and be of sufficient strength to support exterior cladding system. Include sizing in design of cold-formed metal framing system.

B. **Anchor Bolts**: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked, bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. **Expansion Anchors**: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. **Power-Actuated Anchors**: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. **Mechanical Fasteners**: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
   1. **Head Type:** Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. **Welding Electrodes**: Comply with AWS standards.

## 2.6 MISCELLANEOUS MATERIALS

A. **Nonmetallic, Nonshrink Grout**: Premixed, nonmetallic, non-corrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

B. **Sill sealer for exterior steel stud walls**: Provide a sill sealer equal to '**Triple Guard Energy Sill Sealer**' as manufactured by '**Protecto Wrap**'. Seal to have 3/8 inch thick rubberized adhesive membrane that forms an air/vapor moisture barrier system. The seal shall adhere to the face of the foundation, the top of the foundation wall and the face of the sill plate/skirt board.

## 2.7 FABRICATION

A. **Fabricate cold-formed metal framing** and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations 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 metal framing members** by welding. Wire tying of framing members is not permitted. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

4. **Fasten other materials** to cold-formed metal framing by welding, bolting, 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 (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. **Squareness**: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. **Grout bearing surfaces** uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

### 3.3 INSTALLATION, GENERAL

A. **Cold-formed metal framing may be shop or field fabricated** for installation, or it may be field assembled.

B. **Install** cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.

C. **Install** cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
1. **Cut framing members** by sawing or shearing; do not torch cut.
2. **Fasten cold-formed metal framing members** by welding. Wire tying of framing members is not permitted.
   a. **Comply** with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. **Install framing members** in one-piece lengths, unless splice connections are indicated for track or tension members.

E. **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.

F. **Do not bridge building expansion and control joints** with cold-formed metal framing. Independently frame both sides of joints.

G. **Install insulation** in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work. Coordinate with Division 7 Section "Building Insulation."

H. **Fasten hole reinforcing plate** over web penetrations that exceed size of manufacturer's standard punched openings.

I. **Erection Tolerances**: Install cold-formed metal 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 (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

## 3.4 NON-LOAD-BEARING WALL INSTALLATION

A. **Install continuous tracks** sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. **Install sill sealer** as per manufacturer's written instructions

C. **Fasten both flanges of studs** to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: Not more than 16 inches (407 mm).

D. **Set studs plumb**, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

E. **Isolate non-load-bearing steel framing** from building structure to prevent transfer of vertical loads while providing lateral support.
   1. **Connect vertical deflection clips** to bypassing/infill studs and anchor to primary building structure.

F. **Install horizontal bridging** in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. **Bridging:** Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

G. **Install miscellaneous framing** and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

## 3.5 REPAIRS AND PROTECTION

A. **Galvanizing Repairs**: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. **Touchup Painting**: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. **Protect cutouts, corners, and joints** in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

D. **Provide final protection** and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

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# SECTION 05 5000

# METAL FABRICATIONS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. Steel **ladders**.
2. Metal **stairs**
3. **Pipe** and **tube** railings
4. Metal **catwalks.**
5. **Loose bearing** and **leveling plates**.
6. Loose **steel lintels**.
7. **Shelf** angles.
8. **Stainless steel panels** at plumbing fixtures.
9. Steel **framing** and **supports** for countertops.
10. Steel **framing** and **supports** for **mechanical** and **electrical** equipment.
11. Steel **framing** and **supports** for applications where framing and supports are **not specified in other Sections**.
12. Miscellaneous **metal trim**.
13. Pipe **bollards**.

B. **Related Sections** include the following:
1. **Division 5** Section "**Structural Steel**" for structural-steel framing system components.
2. **Division 5** Section "**Wire Cable Railings**".
3. **Division 5** Section "**Glass Railings**" for tempered glass railings.
4. **Division 6** Section "**Miscellaneous Carpentry**" for metal framing anchors and other rough hardware.

### 1.3 SUBMITTALS

A. **Product Data**: For the following:
1. Paint products.
2. Grout.

B. **Shop Drawings General**: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. Provide templates for anchors and bolts specified for installation under other Sections.

C. **Shop Drawings for Stairs**: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

D. **Welding Certificates**: Copies of certificates for welding procedures and personnel.

E. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. **Delegated-Design/Deferred Submittal:** For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.4 QUALITY ASSURANCE

A. **Fabricator Qualifications**: A firm experienced in producing metal fabrications 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.

B. **Welding**: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. **Architectural Exposed Steel**: All exposed steel members shall be detailed, fabricated and erected as **Architecturally Exposed Structural Steel** (AESS) **as defined in the AISC Code of Standard Practice**.

## 1.5 PERFORMANCE REQUIREMENTS FOR METAL STAIRS

A. **Delegated Design/Deferred Submittal**: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. **Structural Performance**: Provide metal stairs capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of metal stairs.
1. **Treads and Platforms of Metal Stairs**: Capable of withstanding a uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m) or a concentrated load of 300 lbf (1.33 kN) on an area of 4 sq. in. (25.8 sq. cm), whichever produces the greater stress.
2. **Stair Framing**: Capable of withstanding stresses resulting from loads specified above in addition to stresses resulting from railing system loads.
3. **Deflection**: Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

## 1.6 PERFORMANCE REQUIREMENTS FOR HANDRAILS

A. **Delegated Design/Deferred Submittal**: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. **General**: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:
   1. **Structural Steel**: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
   2. **Cold-Formed Structural Stee**l: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

C. **Structural Performance of Handrails and Railings**: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
   1. **Top Rail of Guards**: Capable of withstanding the following loads applied as indicated:
      a. **Concentrated load of 200 lbf** (890 N) applied at any point and in any direction.
      b. **Uniform load of 50 lbf/ft**. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
      c. **Concentrated and uniform loads** above need not be assumed to act concurrently.
   2. **Handrails Not Serving As Top Rails**: Capable of withstanding the following loads applied as indicated:
      a. **Concentrated load of 200 lbf** (890 N) applied at any point and in any direction.
      b. **Uniform load of 50 lbf/ft.** (730 N/m) applied in any direction.
      c. **Concentrated and uniform loads** above need not be assumed to act concurrently.
   3. **Infill Area of Guards**: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
      a. **Load above need not be assumed to act concurrently** with loads on top rails in determining stress on guard.

D. **Thermal Movements**: Provide handrails and railings 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. **Control of Corrosion**: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

## 1.7 PROJECT CONDITIONS

A. **Field Measurements General**: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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 construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

B. **Field Measurements for Handrails**: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. **Established Dimensions:** Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.8 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 anchorages for metal stairs**. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.9 CASH ALLOWANCE

A. Contractor shall include an allowance of **$6,400.00** for **miscellaneous steel**, beyond that which is required by the contract documents.

# PART 2 - PRODUCTS

## 2.1 METALS, GENERAL

A. **Metal Surfaces, General**: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.

## 2.2 FERROUS METALS

A. **Steel Plates, Shapes, and Bars**: ASTM A 36/A 36M.

B. **Steel Tubing**: Cold-formed steel tubing complying with ASTM A 500.

C. **Steel Pipe**: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. **Uncoated Hot-Rolled Steel Sheet**: Commercial quality, complying with ASTM A 569/A569M or structural quality, complying with ASTM A 570/A 570M, Grade 30, unless another grade is required by design loads.

E. **Steel and Iron for Handrails**: Provide steel and iron in the form indicated, complying with the following requirements:
   1. **Steel Pipe**: ASTM A 53; finish, type, and weight class as follows:
      a. **Black finish**, unless otherwise indicated.
      b. **Galvanized finish** for exterior installations and where indicated.
      c. **Type F, or Type S, Grade A**, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
   2. **Steel Tubing**: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
   3. **Iron Castings**: Malleable iron complying with ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

F. **Brackets, Flanges, and Anchors**: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

G. **Slotted Channel Framing**: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c.
   1. **Width of Channels**: 1-5/8 inches (41 mm).
   2. **Depth of Channels**: 1-5/8 inches (41 mm).
   3. **Metal and Thickness**: Uncoated steel complying with ASTM A 570, Grade 33; **14 gauge** (1.7-mm) minimum thickness.
   4. **Finish**: Rust-inhibitive, baked-on, acrylic enamel.

H. **Turnbuckles/Clevises**: C-1035, SA-182-F-11, Stainless steel, stub ends - hot rolled steel, galvanized finish. Provide clevis pins meeting load requirements of the rod.
   1. **Equal to**: Cleveland City Forge.

I. **Malleable-Iron Castings**: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

J. **Gray-Iron Castings**: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

K. **Cast-in-Place Anchors in Concrete**: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. **Threaded or wedge type**; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

L. **Welding Rods and Bare Electrodes**: Select according to AWS specifications for metal alloy welded.

## 2.3 ALUMINUM

A. **Aluminum Extrusions**: ASTM B 221 (ASTM B 221M), alloy 6063-T6.

B. **Glazing Channels**: Provide aluminum architectural shapes and extrusions, ASTM alloy 6063-T52, for glazing channels and pockets. Equal to J.G. Braun Company, or C.R. Laurence.

## 2.4 PAINT

A. **Shop Primer for Ferrous Metal**: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

1. Refer to **Section 09 9000 - Painting** for specific primer required on identified steel items.

B. **Galvanizing Repair Paint**: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. **Bituminous Paint**: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FASTENERS

A. **General**: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. **Bolts and Nuts**: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. **Anchor Bolts**: ASTM F 1554, Grade 36.

D. **Machine Screws**: ASME B18.6.3 (ASME B18.6.7M).

E. **Lag Bolts**: ASME B18.2.1 (ASME B18.2.3.8M).

F. **Wood Screws**: Flat head, carbon steel, ASME B18.6.1.

G. **Plain Washers**: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. **Lock Washers**: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. **Expansion Anchors**: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. **Material**: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. **Toggle Bolts**: FS FF-B-588, tumble-wing type, class and style as needed.

## 2.6 GROUT

A. **Nonshrink, Nonmetallic Grout**: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 CONCRETE FILL

A. **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 4000 psi (26.67 MPa), unless otherwise indicated.

B. **Welded Wire Fabric**: ASTM A 185, 6 by 6 inches (152 by 152 mm)--W1.4 by W1.4, unless otherwise indicated.

## 2.8 FABRICATION, GENERAL

A. **Shop Assembly**: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. **Shear and punch** metals cleanly and accurately. Remove burrs.

C. **Ease exposed edges** to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. **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.

E. **Provide for anchorage** of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. **Cut, reinforce, drill, and tap metal fabrications** as indicated to receive finish hardware, screws, and similar items.

G. **Fabricate joints** that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. **Allow for thermal movement** resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. **Form exposed work true to line** and level with accurate angles and surfaces and straight sharp edges.

J. **Remove sharp or rough areas** on exposed traffic surfaces.

K. **Form exposed connections with hairline joints**, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

## 2.9 FABRICATION - STEEL STAIRS

A. **Provide complete stair assemblies**, including metal framing, hangers, struts, 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.
   3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. **NAAMM Stair Standard**: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

C. **Commercial class**, unless otherwise indicated.

D. **Shop Assembly**: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

E. **Form exposed work true to line** and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.

F. **Ease exposed edges** to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. **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 and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

H. **Form exposed connections with hairline joints**, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. **Fabricate joints** that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

## 2.10 STEEL-FRAMED STAIRS

A. **Stair Framing**: Fabricate stringers of structural-steel tubes, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
1. **Where stairs are enclosed by gypsum board** shaft-wall assemblies, provide hanger rods to support landings from floor construction above. Locate hanger rods within stud space of shaft-wall construction.
2. **Where masonry walls support metal stairs**, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

## 2.11 FABRICATION - HANDRAILS

A. **General**: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. **Assemble handrails and railings in the shop** to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. **Form changes in direction of railing members as follows**:
1. By bending.
2. By radius bends of radius indicated.
3. By any method indicated above, applicable to change in direction involved.

D. **Form simple and compound curves** by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

E. **Welded Connections**: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 flux** immediately.
   4. **At exposed connections**, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. **Non-welded Connections**: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

G. **Brackets, Flanges, Fittings, and Anchors**: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

H. **Provide inserts** and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

I. **For railing posts set in concrete**, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

J. **For removable railing posts**, fabricate slip-fit sockets from steel tube whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
   1. **Provide chain with eye**, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

K. **Shear and punch metals cleanly and accurately**. Remove burrs from exposed cut edges.

L. **Ease exposed edges** to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

M. **Cut, reinforce, drill, and tap components,** as indicated, to receive finish hardware, screws, and similar items.

N. **Provide weep holes** or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

O. **Fabricate joints** that will be exposed to weather in a watertight manner.

P. **Close exposed ends** of handrail and railing members with prefabricated end fittings.

Q. **Provide wall returns** at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.

R. **Fillers**: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## 2.12 STEEL LADDERS

A. **General**: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
   1. **Comply** with ANSI A14.3, unless otherwise indicated.
   2. **For elevator pit ladders**, comply with ASME A17.1.

B. **Siderails**: Continuous, 1/2-by-2-1/2-inch (12-by-64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.

C. **Bar Rungs**: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.

D. **Fit rungs in centerline of side rails**; plug-weld and grind smooth on outer rail faces.

E. **Support each ladder at top and bottom** and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. **Provide nonslip surfaces** on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

G. **Provide a protective cage** at locations greater than 20'-0" as required to meet current OSHA regulations.

H. **Provide Galvanized Ladders**, including brackets and fasteners, at all exterior locations.

## 2.13 LOOSE BEARING AND LEVELING PLATES

A. **Provide loose bearing and leveling plates** for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. **Galvanize plates** after fabrication.

## 2.14 LOOSE STEEL LINTELS

A. **Fabricate loose structural-steel lintels** from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. **Weld adjoining members** together to form a single unit where as required.

C. **Size loose lintels** to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. **Galvanize loose steel lintels** located in exterior walls.

## 2.15 SHELF ANGLES

A. **Fabricate shelf angles** from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. **For cavity walls**, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

C. **Galvanize** shelf angles to be installed in exterior walls

D. **Furnish wedge-type concrete inserts**, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.16 MISCELLANEOUS FRAMING AND SUPPORTS

A. **General**: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. **Fabricate units** from structural-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. **Fabricate units from slotted channel framing** where required for deflection.
   2. **Where units are indicated to be cast into concrete** or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
   3. **Furnish inserts** if units must be installed after concrete is placed.

C. **Galvanize** miscellaneous framing and supports in the following locations:
   1. Exterior locations and where miscellaneous items will be concealed from view.

## 2.17 STAINLESS STEEL PANELS AT PLUMBING FIXTURES

A. **Stainless Steel** (S/S): **AISI Type 302/304**, hardest workable temper, No. 4 directional polish, **14 gauge**.

B. **Fabricate metal work surfaces** by forming and welding to provide seamless construction, using welding rods matching sheet metal, grinding and polishing. Where necessary for disassembly, provide waterproof gaskets draw-type joints with concealed bolting.

## 2.18 MISCELLANEOUS STEEL TRIM

A. **Unless otherwise indicated,** fabricate units from structural-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. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. **Galvanize miscellaneous steel trim** in the following locations:
   1. **Exterior**.

## 2.18 PIPE BOLLARDS

A. **Fabricate pipe bollards** from Schedule 40 steel pipe.
   1. Cap bollards with 1/4-inch- (6-mm-) minimum steel plate.

B. **Fabricate sleeves** for bollard anchorage from steel pipe with 1/4-inch (6-mm) thick steel plate welded to bottom of sleeve.

C. **Fabricate internal sleeves** for removable bollards from Schedule 40 steel pipe or 1/4-inch (6-mm) wall-thickness steel tubing with an OD 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 1/2-inch (12-mm) steel machine bolt.

## 2.20 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.

## 2.21 STEEL AND IRON FINISHES

A. **Galvanizing**: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. **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): SSPC-SP 6/NACE No. 3, "**Commercial Blast Cleaning."**
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "**Power Tool Cleaning**."

C. **Application**: 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," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.22 ALUMINUM FINISHES

A. **Finish designations prefixed by AA** comply with the system established by the Aluminum Association for designating aluminum finishes.

B. **Class I, Clear Anodic Finish**: AA-M12C22A41 (**Mechanical Finish**: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. **Fastening to In-Place Construction**: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. **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.

C. **Provide temporary bracing** or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. **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.

E. **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.

F. **Corrosion Protection**: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

## 3.2 INSTALLATION - STEEL STAIRS

A. **Fastening to In-Place Construction**: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. **Cutting, Fitting, and Placement**: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

C. **Install metal stairs by welding** stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. **Provide temporary bracing** or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. **Field Welding**: Comply with 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.

## 3.3 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, 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 nonmetallic, nonshrink grout, unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.4 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of 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 nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.5 INSTALLATION - HANDRAILS

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
   1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
   3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. **Corrosion Protection**: Coat concealed surfaces that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. **Adjust handrails and railings** before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

E. **Fastening to In-Place Construction**: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

## 3.6 RAILING CONNECTIONS

A. **Non-welded Connections**: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. **Welded Connections**: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. **Expansion Joints**: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

## 3.7 ANCHORING POSTS FOR RAILINGS

A. Cover anchorage joint with flange of same metal as post, attached to post as follows:
   1. By set screws.

B. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

## 3.8 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
   1. Connect flanges to railing ends using nonwelded connections.

## 3.9 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.
   3. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

## 3.10 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, if any.

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 at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

## 3.11 INSTALLING PIPE BOLLARDS

A. **Anchor bollards in place with concrete footings**. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

B. **Anchor internal sleeves for removable bollards** in place with concrete footings. Support and brace sleeves in position in footing excavations until concrete has been placed and cured.
   1. **Place removable bollards** over internal sleeves and secure with 1/2-inch (12-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.
   2. **Do not fill** removable bollards with concrete

C. **Fill bollards solidly** with concrete, mounding top surface.

## 3.12 ADJUSTING AND CLEANING

A. **Touchup Painting**: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. **Galvanized Surfaces**: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

**END OF SECTION**

## SECTION 05 5240

## WIRE CABLE RAILINGS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Wire cable** railings.

B. **Related Sections** include the following:
   1. **Division 5** Section "**Metal Fabrications**" for steel pipe handrails and railings included with metal stairs.

### 1.3 PERFORMANCE REQUIREMENTS

A. **General**: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:
   1. **Structural Steel**: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
   2. **Cold-Formed Structural Steel:** AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

B. **Structural Performance of Handrails and Railings:** Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
   1. **Top Rail of Guards:** Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
      b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   2. **Handrails Not Serving As Top Rails:** Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
      b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   3. **Infill Area of Guards:** Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
      a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

C. **Thermal Movements**: Provide handrails and railings 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. **Control of Corrosion:** Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

## 1.4 SUBMITTALS

A. **Product Data:** For the following:
   1. Manufacturer's product lines of mechanically connected handrails and railings.
   2. Grout, anchoring cement, and paint products.

B. **Shop Drawings:** Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Selection: Manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.

D. **Samples for Selection:** Short sections of railing or flat, sheet metal samples showing available mechanical finishes.

## 1.5 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weathertight place.

## 1.6 PROJECT CONDITIONS

A. **Field Measurements:** Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.7 COORDINATION

A. **Coordinate installation of anchorages** for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.8 SCHEDULING

A. **Schedule installation** so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

# PART 2 - PRODUCTS

## 2.1 METALS

A. **General:** Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. **Steel and Iron:** Provide steel and iron in the form indicated, complying with the following requirements:
   1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
      a. Black finish, unless otherwise indicated.
      b. Galvanized finish for exterior installations and where indicated.
   2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   3. Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

C. **Wire Rope:** Specially fabricated 1-by-19 wire rope that is drawn through a die after laying to produce a smooth outer surface; made from wire complying with ASTM A 492, Type 316.
   1. Provide **not less than 1/4 inch(16 mm) diameter** wire rope.
   2. **Basis of Design:** Ronstan International, Inc.

D. **Wire-Rope Fittings**: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
   1. Connectors and terminals shall be stainless steel, with mininum visible parts and no visible threads or screws.

E. **Brackets, Flanges, and Anchors**: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

## 2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. **Welding Electrodes and Filler Meta**l: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. **Fasteners for Anchoring Handrails and Railings to Other Construction:** Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
   1. For stainless-steel handrails and railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.
   2. For steel handrails, railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. **Fasteners for Interconnecting Handrail and Railing Components:** Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
   1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.
   2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. **Cast-in-Place and Postinstalled Anchors**: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
   1. Cast-in-place anchors.
   2. Expansion anchors.

## 2.3 PAINT

A. **Shop Primers**: Provide primers to comply with applicable requirements in Division 9 Section "Painting."

B. **Shop Primer for Ferrous Metal:** Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. **Shop Primer for Galvanized Steel:** Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

D. **Bituminous Paint:** Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.4 GROUT AND ANCHORING CEMENT

A. **Erosion-Resistant Anchoring Cement**: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.5 FABRICATION

A. **General:** Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. **Assemble handrails and railings** in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. **Form changes** in direction of railing members as follows:
   1. **By bending.**

D. **Form simple and compound curves by bending** members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

E. **Welded Connections:** Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. **Nonwelded Connections:** Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

G. **Brackets, Flanges, Fittings, and Anchors:** Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

H. **Provide inserts and other anchorage devices** for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

I. **For railing posts set in concrete**, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

K. **Ease exposed edges** to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

L. **Cut, reinforce, drill, and tap components**, as indicated, to receive finish hardware, screws, and similar items.

M. **Provide weep holes** or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

N. **Fabricate joints** that will be exposed to weather in a watertight manner.

O. Close exposed ends of handrail and railing members with prefabricated end fittings.

P. **Fillers:** Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## 2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Protect mechanical finishes** on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. **Appearance of Finished Work:** Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. **Provide exposed fasteners** with finish matching appearance, including color and texture, of handrails and railings.

## 2.7 STEEL FINISHES

A. **Galvanized Handrails and Railings:** Hot-dip galvanize exterior steel and iron handrails and railings to comply with ASTM A 123. Hot-dip galvanize hardware for exterior steel and iron handrails and railings to comply with ASTM A 153/A 153M.

B. **Fill vent and drain holes** that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. **For galvanized handrails and railings**, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. **For nongalvanized steel handrails and railings**, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. **Preparation for Shop Primin**g: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

F. **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 handrails and railings:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."

G. **Apply shop primer** to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine plaster and gypsum board assemblies**, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. **Perform cutting, drilling, and fitting required** to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
   1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
   3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. **Adjust handrails and railings** before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

D. **Fastening to In-Place Construction:** Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

A. **Nonwelded Connections:** Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. **Welded Connections**: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. **Expansion Joints**: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

## 3.4 ANCHORING POSTS

A. **Use steel pipe sleeves preset and anchored** into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

B. Address anchorage joint as shown on Drawings.

C. **Install removable railing sections**, where indicated, in slip-fit metal sockets cast in concrete.

## 3.5 WIRE CABLE RAILINGS

A. **Install cable railings** in strict accordance with manufacturers printed instruction.
   1. Mark the drill hole locations on all posts. Space cables no more than 4 inches apart and provide a post or vertical spacer at least every 10’-0”.

## 3.6 CLEANING

A. **Touchup Painting:** Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. **Galvanized Surfaces:** Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

## 3.7 PROTECTION

A. **Protect finishes** of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. **Restore finishes** damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**

# SECTION 05 5900

# ARCHITECTURAL JOINT SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Types of joints** for which architectural joint systems are specified include the following:
   1. **Exterior wall** and **soffit** joints.
   2. **Interior pedestrian** traffic joints.
   3. **Interior wall** and **ceiling** joints.
   4. **Wall and ceiling** expansion joint systems.

B. **Related Sections** include the following:
   1. **Division 3** Section "**Cast-in-Place Concrete**" for block-outs and cast-in anchorage and frames for architectural joint systems in concrete floors, parking decks, and walls.
   2. **Division 7** Section "**Sheet Metal Flashing and Trim**" for sheet metal roof and wall joint systems.
   3. **Division 7** Section "**Joint Sealants**" for elastomeric sealants and preformed compressed-foam sealants without metal frames.

### 1.3 DEFINITIONS

A. **Architectural Joint System**: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.

B. **Cyclic Movement**: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

C. **Fire Barriers**: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

D. **Maximum Joint Width**: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

E. **Minimum Joint Width**: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

F. **Movement Capability**: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

G. **Nominal Joint Width**: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

## 1.4 PERFORMANCE REQUIREMENTS

A. **General**: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
   1. **Pedestrian Traffic Joints**: Support pedestrian traffic across joint.
   2. **Exterior Joints**: Maintain continuity of weather enclosure.
   3. **Joints in Fire-Resistance-Rated Assemblies**: Maintain fire-resistance ratings of assemblies.
   4. **Joints in Smoke Barriers**: Maintain integrity of smoke barrier.
   5. **Other Joints**: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
   6. **Seismic Joints**: Remain in place on exposure to seismic activity (movement).
   7. **Joints in Surfaces with Architectural Finishes**: Serve as finished architectural joint closures.

## 1.5 SUBMITTALS

A. **Product Data**: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. **Shop Drawings**: For each joint system specified, provide the following:
   1. **Placement Drawings**: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. **Samples for Selection**: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.
   1. Include similar Samples of material for joints and accessories involving color selection.

## 1.6 QUALITY ASSURANCE

A. **Source Limitations**: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. **Fire-Test-Response Characteristics**: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E 119 and ASTM E 814, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. **Product Options**: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Basis-of-Design Products**: The design for each architectural joint system specified in **Part 2** "**Architectural Joint Systems**" Article below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.

B. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the products indicated in Part 2 "Architectural Joint Systems" Article.

C. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those indicated in **Part 2 "Architectural Joint Systems**" Article.

### 2.2 MATERIALS

A. **Compression Seals**: Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.

B. **Accessories**: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.3 ARCHITECTURAL JOINT SYSTEMS

A. **General**: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

1. **Furnish units in longest practicable lengths** to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
2. **Include closure materials** and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
3. **Frames for Strip Seals**: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.

B. **Architectural Joint System**: Metal frames and preformed seals for **interior wall and ceiling** joints.

1. **Basis-of-Design Product**: **Watson Bowman Acme**; Flatline System Model No. URG or a comparable product.
2. **Maximum Joint Width**: As indicated.
3. **Nominal Joint Width**: As indicated.
4. **Minimum Joint Width**: As indicated.
5. **Movement Capability**: +/- 25%.
6. T**ype of Movement Capability**: Expansion and contraction.
7. **Cyclic-Movement-Test-Response Characteristics**: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
8. **Preformed Seal Material**: Manufacturer's standard polyurethane. Seal Color: Selected by Architect.
9. **Exposed Frame Material**: Aluminum.
10. **Moisture Barrier**: Provide manufacturer's standard unit.

C. **Architectural Joint System**: Metal frames and preformed seals for **wall and ceiling expansion joint systems**.

1. Basis-of-Design Product: **Watson Bowman Acme; FastWrap WC** Model No. 100 or a comparable product.
2. **Type of Movement Capability**: Expansion and contraction.
3. **Cyclic-Movement-Test-Response Characteristics**: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
4. **Preformed Seal Material**: Elastomeric.
   a. **Seal Color**: Selected by Architect.
   b. **Exposed Frame Material**: Aluminum.

D. **Architectural Joint System**: Metal frames and preformed seals for **exterior joints** on **walls and soffits.**

1. **Basis-of-Design Product**: **Watson Bowman Acme**; "**Weather Seal**" or a comparable product.
2. **Provide seismic joint system** that shows no exposed aluminum surfaces incorporating specially engineered elastomeric seals to facilitate movement. The system shall be capable of accommodating multi-directional seismic movement without stress to its components by incorporating seismic-centering bars that have been designed with circular sphered ends that lock, slide and rotate inside a corresponding extrusion cavity. In openings greater than 6 inches manufacturer is to provide a system incorporating multiple seals demonstrating movement without sag or distortion to the seal element. Single seal systems in openings greater than 6 inches that are simply supported by a preformed spring clip will not be allowed.
3. **Visual Seal**: Extruded Elastomeric profile shall be designed with side lugs that mechanically lock into a corresponding aluminum profile. Incorporate features that allow a mechanical connection at all splices between sectional lengths of seal. Material shall be Santoprene or manufacturers alternate material exhibiting a shore A hardness of 64 +/-5.

4. **Secondary Functional Seal:** Extruded Elastomeric profile shall be designed utilizing a serpentine configuration allowing maximum movement and flexibility. Its side lugs shall mechanically lock into a corresponding aluminum profile. Utilization of a common flat sheet good material will not be acceptable. Material shall be a quality flame retardant vinyl with a minimum material thickness of .063.
5. **Maximum Joint Width**: As indicated.
6. **Nominal Joint Width**: As indicated.
7. **Movement Capability**: As indicated.
8. **Type of Movement Capability**: Seismic.
9. **Cyclic-Movement-Test-Response Characteristics**: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
10. **Preformed Seal Material**: Elastomeric.
    a. **Seal Color**: Selected by Architect.
11. **Exposed Frame Material**: Aluminum.
12. **Moisture Barrier**: Provide manufacturer's standard unit.

## 2.4 COMPRESSION TYPE EXPANSION ASSEMBLIES (USE AT ALL LOCATIONS EXCEPT ROOF)

A. **General Provide multi-cellular Elastomeric Seal Profile** that is capable of accommodating movement and variation in joint widths through compression and flexure of its internal web structure. Design web structure with truss like features that exhibit the ability to support pedestrian traffic where applicable and exerts continuous and uniform pressure against joint side walls effectively providing a watertight seal and application. Design top of seal with suitable surface that is non-slip and complies with ADA guidelines when installed. Accommodate multiple sizes of joint openings by providing a variety of sizes.

B. **For horizontal and vertical expansion joints** furnish 'Wabo' colored CompressionSeal, Model WE, as manufactured by Watson Bowman Acme and as indicated on drawings.

C. **Materials**:
1. **Seals**: Seals shall be preformed and manufactured from a **thermoplastic rubber** compound. The seals shall meet the requirements of the properties listed in the table below.

| Physical Properties | ASTM Test Method | Requirements |
|---|---|---|
| Hardness | D-2240 | 64A+/-3 |
| Specific Gravity | D-297 | 0.97+/-2 |
| Tensile Strength | D-412 | 1000 psi |
| Ultimate Elongation | -412 | 4000% |
| Brittle Point | D-746 | -76% |
| High Temperature Recovery (70 hours @ 212°F) | | 82% |

The grade of thermoplastic rubber material shall be UV and ozone resistant

2. **Lubricant Adhesive**: Prima-Lub Adhesive (as recommended by the joint manufacturer) shall be a one part moisture curing polyurethane and aromatic hydrocarbon solvent mixture which complies with ASTM D-4070.
3. **Metal Retainers**: Provide profile or shape of suitable size and design for application indicated on contract drawings. Incorporate factory welded stop bar for all horizontal conditions and as recommended by manufacturer. Metal alloy and method of anchorage shall be governed by architect.
4. **Fire Barrier Assembly**: Designed for indicated or required dynamic structural movement without material degradation or fatigue. Tested in maximum joint width conditions with a field splice as a component of expansion joint cover in accordance with ASTM E-119 at a full rated period by a nationally recognized testing and inspecting organization. Supply Watson Bowman Acme FlameGuard or ThermoShield Fire Barrier as governed by joint opening and fire rating.

D. **Fabrication**:
1. **Seal profiles** shall be shipped in the longest practical continuous length (WE-100 only available in standard ten (10) foot lengths) in manufacturer's standard shipping carton or on wooden pallets shrink wrapped. Seals shall be cut to length on jobsite where required. Miter cut in the field to conform to directional changes utilizing 241F Adhesive and PP Primer, unless otherwise contracted with expansion joint manufacturer.
2. **Lubricant Adhesive** will be shipped in manufacturer's labeled metal gallon containers.
3. **Metal Retainers**: Ship fabricated shapes and profiles in manufacturer's random or pre-cut lengths with factory drilled anchor holes or concrete anchor studs where applicable. Include Seal Stop Bar for all horizontal conditions. Height of Stop Bar shall be governed by architect's requirements for anticipated movement and seal recess. Retainers shall be cut to length on jobsite where required. Miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer. Stack and wire band retainers for shipment.
4. **Fire Barriers**: Ship manufacturer's standard assembly including fire caulks, sealants (if applicable) and hardware for the required hourly rating. Assemblies shall be miter cut in the field to accommodate changes in direction.

E. **Finishes**:
1. **Seals**: Supply in standard color offering: black, beige or gray. Optional custom colors are available. Consult manufacturer for additional custom colors on a special order basis.
2. **Metal Retainers**: Supply in standard mill finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **Prepare substrates** according to architectural joint system manufacturer's written instructions.

B. **Coordinate and furnish anchorages**, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. **Fastening to In-Place Construction**: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

## 3.2 INSTALLATION

A. **Comply with manufacturer's written instructions** for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

B. **Coordinate installation** of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. **Terminate exposed ends** of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

D. **Cutting, Fitting, and Placement**: Perform cutting, drilling, and fitting required to install joint systems.
1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
4. Locate wall, ceiling, and soffit covers in continuous contact with adjacent surfaces.
5. Securely attach in place with required accessories.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

E. **Continuity**: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. **Joint Systems with Seals**: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.

G. **Seismic Seals**: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.

H. **Fire Barriers**: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

## 3.3 CLEANING AND PROTECTION

A. **Do not remove protective covering** until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions

**END OF SECTION**

# SECTION 05 7323

# GLASS RAILINGS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Glass and stainless steel railing systems. All drawings, general and supplementary conditions including Division 1 sections apply to this section.

### 1.2 REFERENCES AND DESIGN REQUIREMENTS

A. **Section includes,** but is not limited to, the following:
1. Custom built, painted steel support posts.
2. Stainless steel mounting hardware, including rods and stand-off buttons to hold tempered glass.
3. Tempered glass panels.

B. **Furnish all components** necessary for a fully functional handrail system.

C. **Related Sections:**
1. **Division 5** Section "**Metal Fabrications**" for steel stair components and standards for steel items used in glass railings.
2. **Division 5** Section "**Cable Railings**" for comparable loadings and structural requirements for hand- and guardrails.

D. **Design requirements** are based on IBC and ADA standards:
1. Guardrails and handrails shall meet or exceed all applicable building codes.
   a. Handrail and guardrail assemblies and attachments shall withstand a minimum concentrated load of 200 pounds applied horizontally or vertically down at any point on the top rail. Infill area of guardrail system capable of withstanding a horizontal concentrated load of 200 pounds applied to one square foot at any point in the system. Load not to act concurrently with loads on top rail of system in determining stress on guardrail. Handrail assemblies and guards shall be designed to resist a load of 50 pounds per linear foot (pound per foot) (0.73 kN/m) applied in any direction at the top and to transfer this load through the supports to the structure.
2. Railings shall have high strength stainless steel to comply with structural requirements with an appropriate safety margin.
3. 1/2 inch thick structural glass panels shall be fully tempered.
4. All internal members shall be stainless steel to eliminate the possibilty of rust.
5. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

### 1.3 DEFINITIONS

A. Terms and definitions from ASTM E985 and ISO/TC 59 for railing related items apply to this section.

## 1.4 SUBMITTALS

A. Conditions of the Contract and Division 1 Specification Sections apply.

B. **Samples:** Provide 6 inch long samples complete with glass, and supports to demonstrate stainless steel grade, glass edgework and finish.

C. **Shop Drawings**: Provide drawings for architectural approval including plans, elevations, sections and details necessary to clearly indicate the design of the railing system and the method of attachment to the various building elements.

D. **Structural Computations:** Provide calculations prepared by a structural engineer licensed in the state of the project to demonstrate satisfactory structural compliance to applicable building codes. Calculations, when possible, should be based on final fabrication drawings.

E. **Maintenance instructions**: Provide manufacturer's maintenance and cleaning instructions.

F. **Warranty**: Provide manufacturer's warranty effective from completion of work.

G. **Qualification Data**: Qualification data for factory authorized installers specified in Quality Assurance is to demonstrate their capabilities and experience. Include list of completed projects with project and architect names.

## 1.5 QUALITY ASSURANCE

A. Provide all materials, labor and equipment necessary to fabricate and completely install handrails, guardrails, and infill panels as shown on Drawings or specified herein.

B. **Single Source Responsibility:** Materials shall be supplied and installed by manufacturer or manufacturer approved installer.

C. **Execution Tolerance**: plus/minus 5/64 inch (2 mm).

## 1.6 STORAGE

A. Store handrails and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind.

B. Materials must be kept in original packing until installation.

C. Materials to be stored at not lower than -40°C (-40°F) or higher than 100°C (212°F).

## 1.7 PROJECT CONDITIONS

A. Take all measurements for handrails and railings from construction site elements to which railings are to fasten. This information to be recorded on final shop drawings.

B. Coordinate fabrication schedule with construction progress to avoid delay of work.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. **Basis of Design:** Contract Documents are based on portions of system specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Architectural Railings and Grilles, Inc.; www.stainless-railing.com.
   2. **Product:** Civic 2-Line (rod, glazing, and stand-off components only).

B. **Construct rails and other tubular components** of the following:
   1. **Stainless stee**l grade UNS 1.4305, type 304; surface to be 240 grain/grit finish; tubes 1-1/2 inches (38mm) outside diameter by 5/64 inch wall thickness; rods 7/16 inch outside diameter schedule 40 pipe (or as required for structural design).

C. **Trims and exposed metal** for interior structural glass to be stainless steel grade UNS 1.4305, type 304, surface to be 240 grain/grit.

D. **Fastening Bolts:** Stainless steel as determined by engineering requirements.

E. Use **neoprene gasket material** at all through-bolt connections to ensure separation between metal and glass.

F. **Support Posts:** 3/8 inch steel plate, ground smooth, shop primed for field finish. Weld connections and grind welds smooth.

### 2.2 GLASS PRODUCTS, GLAZING AND INFILL MATERIALS.

A. **Tempered Glass:** Provide fully tempered safety glass with polished edges and dubbed (blunt) corners complying with ASTM C1048. Kind FT (fully tempered), condition A (un-coated). Types 1 (transparent glass, flat), quality Q3 (glazing select), class, thickness and manufacturing process as indicated below.

B. **Clear glass**: Class 1 clear.

C. **Allowable Thickness:**
   1. 1/2 inch thick fully tempered structural glass panels with edges ground smooth and polished.

D. **Manufacturing Process:** Manufacture fully tempered glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed. Drill any required holes prior to tempering process.

E. **Structural glass railing to be designed** for compliance with appropriate building codes. Structural computations showing material properties and other information needed to ensure satisfactory structural compliance to applicable building codes to be supplied by the manufacturer - based on final fabrication drawings and documents, anchoring type, spacing and glass thickness.

## 2.3 FASTENERS

A. **Types and sizes** indicated in shop drawings. All mechanical fasteners used shall be manufactured from stainless steel.

B. **Fabricate anchors** from stainless steel or other materials as determined by engineering requirements with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing per ASTM E488.

## 2.4 FABRICATION

A. **Fabricate railing system** for compliance with structural requirements of applicable code.

B. **Glass support system:** 2 pipes supporting glass on button connections; minimum diameter of rods: 7/16 inch. Size as required for structural performance. Pipes shall pass thru and be supported by painted steel posts.

C. **Pre-assemble railings** prior to shipping to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and for coordination with shop drawings.

D. **Tubing cuts shall be square**, without burrs and where exposed, rounded to produce smooth rigid and hairline joints.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Provide information on fastening point locations for posts where necessary to relevant parties.

## 3.2 INSTALLATION

A. Installation shall be by a **qualified, authorized representative** of the manufacturer.

B. **Installation must be in accordance** with standard or non-standard, yet applicable details (instructions) included on installation/shop drawings provided by manufacturer.

C. **Install components plumb and in-line**, accurately fitted, free from distortion or defects and securely anchored to structure.

D. **Provide anchors**, plates, angles, etc., necessary for connecting railings to structure.

E. **Field welding** shall be by a certified welder.

F. **Weld** stainless steel handrails and top rails to steel supports.

G. Access for anchors that require through-bolting either vertically or horizontally to be made available through General Contractor.

## 3.3 ERECTION TOLERANCES

A. Maximum variation from plumb shall be 1/4 inch.

B. Maximum offset from true alignment for every 50-foot of railing shall be 1/4 inch, non-accumulative.

## 3.4 PROTECTION AFTER INSTALLATION

A. General Contractor to provide protective covering on handrails and guardrails if construction is not yet finished in the area where the railings are installed.

## 3.5 MAINTENANCE AND CLEANING

A. Railings shall be cleaned, including infill panels, by contractor to the satisfaction of the owner.

B. Wipe with moistened cloth only. Do not use cleaning agents with abrasive or acid/alkaline content.

## 3.6 CORRECTION OF DEFICIENCIES

A. All deficiencies in work and/or items not meeting specified requirements shall be corrected in order to meet specification requirements at no additional cost to Owner.

**END OF SECTION**

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# DIVISION 6 - WOOD AND PLASTIC


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|---|---|
| Section 06 1050 | Miscellaneous Carpentry |
| Section 06 2100 | Wood/Polymer Timber |
| Section 06 4020 | Interior Architectural Woodwork |

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**SECTION 06 1050**

**MISCELLANEOUS CARPENTRY**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. **Rooftop equipment bases** and support curbs.
2. **Wood furring,** grounds, nailers, and blocking.
3. Provide **solid wood blocking** at the following locations including, but not limited to:
   a. Pencil sharpeners.
   b. Door stops.
   c. Grab bars.
   d. Parapet Caps
   e. Wall mounted toilet accessories.
   f. Provide 2 rows each at base and upper cabinets and casework.
   g. TV brackets.
   h. Toilet partitions.
   i. Mirrors.
   j. Markerboards.
   k. Other wall mounted fixtures.
4. **Wood based structural** use panels.
5. **Plywood backing** panels (for telephone and electrical equipment).
6. **Engineered** wood products.

B. **Related Sections:** The following Sections contain requirements that relate to this Section:
1. **Division 9** Section **"Non-Load Bearing Steel Framing"** for **metal strap blocking.**

### 1.3 SUBMITTALS

A. **General**: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Wood treatment data as follows**, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
1. **For each type of preservative-treated wood product**, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. **For waterborne-treated products**, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

C. **Submit research reports** or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
   1. Engineered wood products.

D. **Material test reports** from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with performance requirements indicated.

E. **Warranty of chemical treatment** manufacturer for each type of treatment.

## 1.4 DELIVERY, STORAGE, AND HANDLING

A. **Keep materials under cover and dry**. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
   1. **For lumber and plywood pressure treated** with waterborne chemicals, place spacers between each bundle to provide air circulation.

# PART 2 - PRODUCTS

## 2.1 LUMBER, GENERAL

A. **Lumber Standards**: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. **Inspection Agencies**: Inspection agencies, and the abbreviations used to reference them, include the following:
   1. **NELMA** - Northeastern Lumber Manufacturers Association.
   2. **RIS** - Redwood Inspection Service.
   3. **SPIB** - Southern Pine Inspection Bureau.
   4. **WCLIB** - West Coast Lumber Inspection Bureau.
   5. **WWPA** - Western Wood Products Association.

C. **Grade Stamps**: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
   1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece.

D. **Nominal Sizes**: Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   1. **Provide dressed lumber, S4S**, unless otherwise indicated.
   2. **Provide dry lumber** with **19 percent** maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. **General**: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
   1. **Do not use chemicals** containing **chromium** or **arsenic**.
   2. **For exposed items** indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. **Pressure treat aboveground items** with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
   1. **Wood cants**, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. **Wood sills**, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. **Pressure treat wood members in contact with ground** or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

## 2.3 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

A. **General**: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
   1. **Current Evaluation/Research Reports**: Provide fire-retardant- treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant- treated wood for application indicated.

B. **Interior Type A**: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
   1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.
   2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
   3. No corrosion of metal fasteners results from their contact with treated wood.

C. **Exterior Type**: Use for exterior locations and where indicated.

D. **Inspection**: Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

E. **Products**: Subject to compliance with requirements, provide one of the following:
   1. **Interior Type A** Fire-Retardant-Treated Wood:
      a. "**Dricon**" Hickson Corporation.
      b. "**Pyro-Guard**" Hoover Treated Wood Products.
      c. "**Flameproof LHC-HTT**" Osmose Wood Preserving Co, Inc.
   2. **Exterior Type** Fire-Retardant-Treated Wood:
      a. "**Exterior Fire-X**" Hoover Treated Wood Products.

## 2.4 DIMENSION LUMBER

A. **General**: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
   1. **Grade**: Standard, Stud, or No. 3.
   2. **Species**: Hem-fir; WCLIB or WWPA.

B. **Heavy Timber Members** at **Entries**:
   1. **Species**: Douglas Fir.
   2. **Grade**: **WCLIB No, 1 grade**, wood is to be "**free of heart**" with exterior glue and rated for exterior exposure.

## 2.5 MISCELLANEOUS LUMBER

A. **General**: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. **Fabricate miscellaneous lumber** from dimension lumber of sizes indicated and into shapes shown.

C. **Moisture Content**: 19 percent maximum for lumber items are not specified to receive wood preservative treatment.

D. **Grade**: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

## 2.6 ENGINEERED WOOD PRODUCTS (GLU-LAM BEAMS)

A. **Laminated Veneer Lumber**: A composite of wood veneers with grain primarily parallel to member lengths, manufactured with an exterior type adhesive complying with ASTM D 2559. Product has the following allowable design values as determined according to ASTM D 5456:
   1. **Extreme Fiber Stress in Bending, Edgewise**: 2600 psi (17.9 MPa) for 12-inch nominal- (286-mm) actual- depth members.
   2. **Modulus of Elasticity, Edgewise**: 1,800,000 psi (12 400 MPa).

## 2.7 WOOD-BASED STRUCTURAL-USE PANELS

A. **Miscellaneous Concealed Plywood**: C-C Plugged Exterior, thickness as indicated but not less than 1/2 inch (12.7 mm).

B. **Miscellaneous Exposed Plywood**: A-D Interior, thickness as indicated but not less than 1/2 inch (12.7 mm).

## 2.8 PLYWOOD BACKING PANELS

A. **For mounting electrical** or **telephone** equipment, provide fire-retardant-treated plywood panels with grade, **C-D Plugged Exposure 1**, in thickness indicated or, if not otherwise indicated, not less than **15/32 inch** (11.9 mm) thick.

## 2.9 FASTENERS

A. **General**: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. **Nails, Wire, Brads, and Staples**: FS FF-N-105.

C. **Power-Driven Fasteners**: CABO NER-272.

D. **Bolts**: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

## 2.10 METAL FRAMING ANCHORS

A. **General**: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
   1. **Research or Evaluation Reports:** Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
   2. **Allowable Design Loads**: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. **Galvanized Steel Sheet**: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. **Discard units of material with defects** that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. **Set carpentry to required levels** and lines, with members plumb, true to line, cut, and fitted.

C. **Fit carpentry to other construction**; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. **Apply field treatment** complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. **Securely attach carpentry work** as indicated and according to applicable codes and recognized standards.

F. **Countersink nail heads** on exposed carpentry work and fill holes with wood filler.

G. **Use fasteners of appropriate type and length**. Predrill members when necessary to avoid splitting wood.

## 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. **Install where shown** and where required for screeding or attaching other work. Cut and shape to required size. Coordinate locations with other work involved.

B. **Attach to substrates** to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

## 3.3 WOOD FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

## 3.4 INSTALLATION OF STRUCTURAL-USE PANELS

A. **General**: Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
   1. Comply with "Code Plus" provisions of above-referenced guide.

**END OF SECTION**

# SECTION 06 2100

# WOOD/POLYMER TIMBER

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Wood/polymer timber for locker room benches.

B. **Related Section**s: The following Sections contain requirements that relate to this Section:
   1. **Division 5** Section "**Metal Fabrications**" for locker room benches pedestals and supports.
   2. **Division 6** Section "**Miscellaneous Carpentry**" for furring, blocking, and other carpentry work not exposed to view.

### 1.3 SUBMITTALS

A. **General:** Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data** for each type of factory-fabricated product and process specified, including details of construction relative to materials, dimensions of individual components, profiles, textures, and colors.

C. **Samples:** Provide a full range of color samples for selection by the Architect.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications:** Engage an experienced Installer who has completed finish carpentry similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Delivery and Storage:** Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

B. **Do not deliver interior finish carpentry** until environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations:** Do not deliver or install interior finish carpentry until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through the remainder of construction period.

# PART 2 - PRODUCTS

## 2.1 WOOD/POLYMER TIMBER

A. Provide wood/polymer material comprised of approximately 50% reclaimed wood and 50% reclaimed plastic and meeting the following physical and mechanical properties.

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. **TREX** Company, Inc.; Origins.

**PHYSICAL AND MECHANICAL PROPERTIES**

| PROPERTY | TEST METHOD | VALUE |
|---|---|---|
| Abrasion Resistance | ASTM D2394 | 0.01 wear/1000 res. |
| Hardness | ASTM D143 | 1124 lbs. |
| Self Ignition Temperature | ASTM D1929 | 743 F |
| Flash Ignition Temperature | ASTM D1929 | 698 F |
| Flame Spread (a) | ASTM E84 | 80 |
| Water Absorption (sanded surface)24 hr. immersion | ASTM D1037 | 4.3% |
| Water Absorption (un-sanded surface)24 hr. immersion | ASTM D1037 | 1.7% |
| Nail Withdrawal (c) | ASTM D1761 | 163 lbs/in |
| Screw Withdrawal (c) | ASTM D1761 | 558 lbs/in |
| Static Coefficient of Friction - Dry (d) | ASTM D2047 | 0.53/0.55 |
| Static Coefficient of Friction - Dry (d) | ASTM F1679 | 0.59/0.70 |
| Static Coefficient of Friction - Wet (d) | ASTM F1679 | 0.70/0.75 |
| Fungus Resistance (White & Brown Rot) | ASTM D1413 | rating = No Decay |
| Termite Resistance (e) | AWPAE1-72 | rating = 9.6 |
| Specific Gravity (typical) | ASTM D2395 | 0.91 to 0.95 |

| PROPERTY | TEST METHOD | ULTIMATE VALUES | DESIGN VALUES |
|---|---|---|---|
| Compression Parallel (f)(g) | ASTM D198 | 1806 psi | 550 psi |
| Compression Perpendicular (f)(h) | ASTM D143 | 1944 psi | 625 psi |
| Tensile Strength (f) | ASTM D198 | 854 psi | 250 psi |
| Shear Strength (f) | ASTM D143 | 561 psi | 200 psi |
| Modulus of Rupture (f) | ASTM D4761 | 1423 psi | 250 psi |
| Modulus of Elasticity (f) | ASTM D4761 | 175,000 psi | 100,000 psi |
| Thermal Conductivity | ASTM C177 | 1.57 BTU-in/hr-ft @85 F | |
| Leachate (i) | TCLP-EPA 1311 | pass | |

Expansion/Contraction Properties (b)

| | |
|---|---|
| Thermal | Typical Trex Wood Polymer lumber values for Coefficient of Thermal Expansion/Contraction (36" long samples) Width: 35.2 x 10-6 to 42.7 x 10-6 (inch/inch/ F) Length: 16.1 x 10-6 to 19.2 x 10-6 (inch/inch/ F) |
| Moisture: | Typical Trex Wood Polymer lumber values for<br>Long Term Water Immersion 36" long samples: Width ~3%<br>Constant High Humidity 6" long samples: Width ~1% |

Notes:

(a) Corresponding Smoke Developed Index is 285

(b) Values shown are for reference only. These values should not be used to calculate gapping for Trex Wood-Polymer lumber. Follow Trex Wood-Polymer lumber installation literature for proper width-to-width and end to end gapping information.

(c) 8d common wire nail. No. 10 wood screw.

(d) ASTM D2047 test conducted on sanded/unsanded unweathered samples with leather surface. ASTM F1679 test conducted on sanded/unsanded weathered samples with neolite surface.

(e) Material weight loss was 0%.

(f) Ultimate strength values are not meant for design analysis. Testing performed on a 2x6 cross section. Design values are for temperatures up to 130 F.

(g) Compressive strength parallel to the length.

(h) Compressive strength perpendicular to length.

(i) Leaching was below levels established by EPA for all constituent categories.

## 2.2 MISCELLANEOUS MATERIALS

A. **Fasteners for Interior Finish Carpentry:** Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

1. Where finish carpentry materials are exposed in areas of high humidity, provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A 153.
2. Provide pedestals, supports and other locker room bench metal fabrications in accordance with Division 5 Section "Metal Fabrications."

## 2.3 FABRICATION

A. **Fabricate** finish carpentry to dimensions, profiles, and details indicated.

1. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius.
2. Ease edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and performance of finish carpentry. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. **Clean substrates** of projections and substances detrimental to application.

B. **Condition finish carpentry** to average prevailing humidity conditions in installation areas before installation, for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

### 3.3 INSTALLATION, GENERAL

A. **Do not use finish carpentry materials that are unsound**, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
   1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. I**nstall finish carpentry plumb, level, true, and aligned** with adjacent materials. Use concealed shims where required for alignment.
   1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Drill pilot holes before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.
   3. Countersink nails, fill surface flush, and sand where face nailing is unavoidable.
   4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) for plumb and level. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
   5. Coordinate finish carpentry with materials and systems in or adjacent to standing and running trim and rails.

C. **Anchor locker benches** to uniformly spaced brackets/pedestals not more than 60 inches (1525 mm) apart, and securely fasten to bench top and anchor to masonry base. Fasten wood-polymer boards from the underside to avoid face fasteners.

### 3.4 ADJUSTING

A. **Repair damaged or defective finish carpentry** where possible to eliminate functional or visual defects. **Where not possible to repair, replace** finish carpentry. Adjust joinery for uniform appearance.

## 3.5 CLEANING

A. **Clean finish carpentry** on exposed and semi-exposed surfaces.

## 3.6 PROTECTION

A. **Provide final protection** and maintain conditions that ensure finish carpentry is without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

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# SECTION 06 4020

# INTERIOR ARCHITECTURAL WOODWORK

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
1. Interior architectural **millwork and casework**.
2. Interior **standing** and **running** trim.
3. **Countertops and window sills.**
4. **Flush wood** paneling and **wainscots**.
5. **Interior ornamental** work.
6. **Shop finishing** of woodwork.

### 1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction prior to woodwork installation.

### 1.4 SUBMITTALS

A. **General:** Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Product data** for each type of product and process specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

C. **Shop drawings** showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.

D. **Samples** for verification of the following:
1. Lumber with or for transparent finish, 50 sq. in. (300 sq. cm), for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Thermoset decorative-overlay surfaced panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
4. Plastic-laminate-clad panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.

## 1.5 QUALITY ASSURANCE

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

B. **Single-Source Responsibility** for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.

C. **Quality Standard**: Except as otherwise indicated, comply with the following standard:
   1. **AWS Quality Standard:** "Architectural Woodwork Standards - Edition 1" of the Architectural Woodwork Institute/ Architectural Woodwork Manufacturers Association of Canada / Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.
      a. Provide AWI Certification Labels or Certificates of Compliance indicating that woodwork meets requirements of grades specified.

D. **Mockups:** Before fabricating and installing interior architectural woodwork, build mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the 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 installed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before starting interior architectural woodwork fabrication.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed.
   7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Protect woodwork during transit**, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. **Do not deliver woodwork** until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

## 1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. **Field Measurements**: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. **Verify locations** of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.
   2. **Where field measurements cannot be made** without delaying the Work, guarantee dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site and coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

## 1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

# PART 2 - PRODUCTS

## 2.1 WOODWORK FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:
   1. **Huetter** Mill and Cabinet Company.
   2. **Granite** Mill and Fixture Company.
   3. **Anderson** Mill, Inc.
   4. **Swainston** Mill.
   5. **HURCO.**
   6. **Johnson** Brothers.
   7.

## 2.2 MATERIALS

A. **General**: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:
   1. **Hardboard**: AHA A135.4.
   2. **Particleboard:** ANSI A208.1, Grade M-2.
   3. **Softwood Plywood:** PS 1.
   4. **Hardwood Plywood and Face Veneers:** HPVA HP-1.
   5. **Medium Density Fiberboard (MDF)**: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

B. **Particleboard**: ANSI A208.1, Grade M-2 made with phenol-formaldehyde resins.

C. **Wood Species** and Cut for Transparent Finish: **Select White maple**, plain sawn or sliced.

D. **High-Pressure Decorative Laminate:** NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
   1. **Acceptable Laminate Manufacturers:** Subject to compliance with the Contract Documents, provide products from one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the provisions of Division 1 Sections
      a. **Formica** Corporation.
      b. **Nevamar** (Panolam).
      c. **Pionite**.
      d. **WilsonArt**.

E. **Adhesive for Bonding Plastic Laminate**: Contact cement.

F. **Thermoset Decorative Overlay**: Decorative surface of thermally fused polyester or melamine-impregnated web, bonded to specified substrate and complying with ALA 1992.
   1. **Substrate**: Medium-density particleboard, ANSI A208.2, Grade MD; made with binder containing no urea formaldehyde.

G. **Solid-Surfacing Material:** Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
   1. **Acceptable Solid Surface Manufacturers:** Subject to compliance with the Contract Documents, provide products from one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the provisions of Division 1 Sections.
      a. **DuPont Polymers**; "Corian".
      b. **Formica** Corp.; "Solid Surfacing".
      c. **Samsung**; "Staron".

## 2.3 CABINET HARDWARE AND ACCESSORY MATERIALS

A. **General:** Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware."

B. **Finish Hardware**:
   1. **Hinges**: 2-3/4" five-knuckle hospital-tip 270 degree swing hinge satin chrome finish. Doors up to 48" in height shall have 2 hinges per door. Doors over 48" in height shall have 3 hinges per door. Hinges which require cutting the edge-banding off the door will not be allowed.
   2. **Drawer Slides**: Drawer slides for standard drawers shall be Blum BS230E or equal with 100 pound rating and baked enamel corrosion resistant finish. File drawers and paper drawer slides shall be KV 8500 or equal full extension with 150 pound rating.
   3. **Pulls**: Liberty Hardware or equivalent, semi circular wire steel pull with satin nickel finish, 128 mm C-to-C, model no. P84612-SN-C1.

4. **Catches**: Friction roller catch equal to Hafele 241.01.719 or Amerock 9823-2G.
5. **Adjustable Shelf Supports**:
   a. Adjustable shelves shall be supported on adjustable shelf supports inserted in shelf holes drilled into the case ends or partitions and adjustable on 32mm (1 1/2") centers. Supports to be KV 346 clips.
6. **Locks**: Locks for drawers and 3/4" hinged doors shall be National Lock #8053 disc tumber. Locks to have a three level keying system, coordinate with owner for master locks and keying system
7. **Coat Hooks**: Ives 572 F-15C.1 dull chrome.
8. **Wall Shelf Standards**: Heavy-duty, double-tracked, double-formed, 2" based standards. Epoxy powder finish. Equal to Newtech Hardware.
9. **Wall Shelf Brackets**: 1" wide x 5/8" deep double slotted brackets adjustable on 1-3/4" centers. Equal to Newtech Hardware.
10. **File drawer slides**: KV 8500 full extension.
11. **Screws**: Reed and Prince square drive screws. Standard wood screws and sheet metal screws are not acceptable.
12. **Casters**: PPI, Heavy Duty Plastic Wheel, 4" diameter x 1-1/4" tread width, plain bearing, 300 lb. capacity, 5-1/8" high, swivel operation, no. 20-40S-A1-HP/20-40S-A1-HP-TB (top lock brake).
13. **Fully Articulated Keyboard Arm**: Hafele, 639.96.305, Black Plastic, Black Steel.
14. **Keyboard Tray**: Hafele, 639-96-396, Black Polymer Finish.
15. **Cable Grommets**: HAFELE, 429.94.310, zinc die-cast, black finish.

## 2.4 INSTALLATION MATERIALS

A. **Furring, Blocking, Shims, and Hanging Strips**: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. **Screws**: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.
   1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.

C. **Nails:** Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

D. **Anchors:** Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

## 2.5 FABRICATION, GENERAL

A. **Interior Woodwork Grade**: Provide interior woodwork complying with the referenced quality standard and of the following grade:
   1. **Grade: Premium.**

B. **Wood Moisture Content**: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

C. **Fabricate woodwork to dimensions**, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. **Corners of cabinets** and edges of solid-wood (lumber) members and rails: 1/16 inch (1.5 mm).

D. **Complete fabrication,** including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. **Trial fit assemblies** at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.

E. **Shop-cut openings**, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

## 2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. **Quality Standard**: Comply with **AWS Section 6**.

B. **Grade: Premium**.

C. **For trim items wider than available lumber**, use veneered construction. Do not glue for width.

D. **For rails wider or thicker than available lumbe**r, use veneered construction. Do not glue for width or thickness.

E. **Backout or groove backs** of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

F. **Assemble casings** in plant except where limitations of access to place of installation require field assembly.

G. **Assemble moldings** in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

H. **Hardwood Lumber Trim for Transparent Finish** (Stain or Clear Finish): Clear, kiln-dried, Natural White Maple, plain sawn or sliced, finished lumber (S4S).

## 2.7 LAMINATE-CLAD CABINETS WITH MDF DOOR AND DRAWER FACES

A. **Quality Standard:** Comply with **AWS Section 10** requirements for laminate-clad cabinets.
   1. **Grade: Premium**.

B. **AWI Type of Cabinet Construction**: Flush overlay; door and drawer faces cover cabinet fronts with only enough space between faces for operating clearance

C. **MDF Door and Drawer Fronts:**
1. 3/4 inch thick, medium density fiberboard, CNC machined.

D. **Materials for Semiexposed Surfaces**: Provide surface materials indicated below:
1. **Surfaces Other than Drawer Bodies**: High-pressure decorative laminate, Grade GP-28.
2. **Drawer Sides and Backs:** Thermoset decorative overlay.
3. **Drawer Bottoms:** Thermoset decorative overlay.

E. **Colors, Patterns, and Finishes**: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. **Match color, pattern, and finish** indicated by reference to laminate manufacturer's standard designations for these characteristics.

F. **Provide dust panels** of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers except where located directly under tops.

## 2.8 COUNTERTOPS

A. **Quality Standard**: Comply with **AWS Section 11** requirements for countertops.
1. Grade: Premium.

B. **Type of Top**: High-pressure decorative laminate complying with the following:
1. **Grade:** GP-50, 0.050-inch (1.270-mm) nominal thickness.
2. **Colors, Patterns, and Finishes**: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   a. **Match color, pattern, and finish** indicated by reference to manufacturer's standard designations for these characteristics.
3. **Edge Treatment:** Same as laminate cladding on horizontal surfaces.
4. **Core Material:** Medium-density particleboard.

## 2.9 FLUSH WOOD PANELING AND WAINSCOTS

A. **Quality Standard:** Comply with AWS Section 4 requirements for flush wood paneling.

B. **Grade: Premium.**

C. **Wood Species and Cut**: Clear, kiln-dried, **Select White Maple,** quarter sawn or sliced, finished lumber (S4S).
1. **Lumber Trim and Edges**: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.

D. **Matching of Adjacent Veneer Leaves:** Book match.

E. **Vertical Matching of Adjacent Veneer Leaves**: End match.

F. **Veneer Matching within Panel Face**: Running match.

G. **Panel-Matching Method:** Match panels within each separate area by the following method:
   1. Sequence-matched, uniform-size sets.

H. **Vertical Panel-Matching Method:** End match.

## 2.10 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. **Quality Standard:** Comply with **AWS Section 6**.

B. **Grade: Premium**.

C. **Wood Species and Cut**: Clear, kiln-dried, **Select White Maple**, plain sawn or sliced, finished lumber (S4S).

## 2.11 SHOP FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. **Quality Standard:** Comply with **AWS Section 5**, unless otherwise indicated.

B. **General:** The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation.
   1. **Shop Finishing:** The extent to which the final finish is applied to architectural woodwork at the fabrication shop is the Contractor's option, except shop apply at least the prime/base coat to the greatest extent possible before delivery.

C. **Preparations for Finishing:** Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of trim, cabinets, paneling, and ornamental work and the underside of countertops. Apply 2 coats to back of paneling. Concealed surfaces of plastic laminate-clad woodwork do not require backpriming when surfaced with plastic laminate or thermoset decorative overlay.

D. **Washcoat for Stained Finish:** Apply a vinyl washcoat to woodwork made from closed-grain wood before staining and finishing.

E. **Transparent Finish:** Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
   1. **Grade: Premium.**
   2. **AWS Finish System 11**: Catalyzed polyurethane.
   3. **Staining:** Match Architect's sample.
   4. **Wash Coat for Stained Finish:** Apply a vinyl wash coat to woodwork made from closed-grain wood before staining and finishing.
   5. **Open Finish for Open-Grain Woods**: Do not apply filler to open-grain woods.
   6. **Filled Finish for Open-Grain Woods:** After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
      a. Apply vinyl wash coat sealer after staining and before filling.
   7. **Sheen:** Satin, 30-50 Gloss units.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **Condition woodwork** to average prevailing humidity conditions in installation areas before installing.

B. **Before installing architectural woodwork,** examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

### 3.2 INSTALLATION

A. **Quality Standard**: Install woodwork to comply with **AWI Section 1700** for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. **Install woodwork** plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) for plumb and level (including tops).

C. **Scribe and cut woodwork** to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. **Anchor woodwork** to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. **Standing and Running Trim:** Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
   1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
   2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

F. **Cabinets**: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
   2. Maintain veneer sequence matching of cabinets with transparent finish.

G. **Tops:** Anchor securely to base units and other support systems as indicated. Calk space between backsplash and wall with specified sealant.
   1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
   2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.

H. **Paneling:** Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless covered by trim or otherwise indicated.

1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

I. **Complete the finishing work specified** in this Section to the extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in the shop.

## 3.3 ADJUSTING AND CLEANING

A. **Repair damaged and defective woodwork** where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. **Clean**, lubricate, and adjust hardware.

C. **Clean woodwork** on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

## 3.4 PROTECTION

A. **Provide final protection** and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

# DIVISION 7 – THERMAL AND MOISTURE PROTECTION


| | |
|---|---|
| Section 07 0150.19 | Preparation for Re-Roofing |
| Section 07 1110 | Bituminous Dampproofing |
| Section 07 1320 | Self-Adhering Sheet Waterproofing |
| Section 07 1800 | Traffic Coatings |
| Section 07 1900 | Water Repellents |
| Section 07 2100 | Building Insulation |
| Section 07 2729 | Fluid Applied Air and moisture Barrier |
| Section 07 4213 | Metal Wall Panels |
| Section 07 4243 | Composite Metal Wall Panel |
| Section 07 5416 | Ethylene Interpolymer roofing |
| Section 07 5421 | Polyvinyl – Chloride (PVC) Roofing |
| Section 07 6200 | Sheet Metal Flashing and Trim |
| Section 07 7200 | Roof Accessories |
| Section 07 8113 | Sprayed Fire-Resistive Materials |
| Section 07 8126 | Intumescent Paints |
| Section 07 8400 | Through-Penetration Firestop System |
| Section 07 8443 | Fire-Resistant Joint Sealants |
| Section 07 9200 | Joint Sealants |

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# SECTION 07 0150.19

# PREPARATION FOR RE-ROOFING

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Removal of existing roofing system in preparation for a new roof membrane system.

### 1.2 RELATED REQUIREMENTS

A. **Division 5** Section "**Steel Deck**" for replacement of existing steel deck where noted on Drawings or where required due to infill or modification of existing deck.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with affected mechanical and electrical work associated with roof penetrations.

B. **Preinstallation Meeting**: Convene one week before starting work of this section.
   1. Meeting shall include representatives of new roofing system and shall be coordinated with new installation.

C. Schedule work to coincide with commencement of installation of new roofing system.

### 1.4 QUALITY ASSURANCE

A. **Materials Removal Firm Qualifications**: Company specializing in performing the work of this section with minimum 5 years of documented experience.

### 1.5 FIELD CONDITIONS

A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.

B. Maintain continuous temporary protection prior to and during installation of new roofing system.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. **Temporary Protection:** Sheet polyethylene; provide weights to retain sheeting in position.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that existing roof surface is clear and ready for work of this section.

## 3.2 PREPARATION

A. Sweep roof surface clean of loose matter.

B. Remove loose refuse and dispose off site.

## 3.3 MATERIAL REMOVAL

A. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.

B. Remove metal counter flashings.

C. Remove roofing membrane, perimeter base flashings, flashings around roof protrusions, pitch pans and pockets and any other items interfering with the proper installation of new roofing system.

D. Remove insulation and fasteners, cant strips, blocking.

E. Remove vapor retarder and other components, down to the metal deck.

F. Repair existing steel deck surface to provide smooth working surface for new roof system. Replace portions of steel deck where required.

## 3.4 PROTECTION

A. Provide temporary protective sheeting over uncovered deck surfaces.

B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.

C. Provide for surface drainage from sheeting to existing drainage facilities.

D. Do not permit traffic over unprotected or repaired deck surface.

**END OF SECTION**

## SECTION 07 1110

## BITUMINOUS DAMP PROOFING

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes cold-applied, emulsified asphalt dampproofing** applied to the following surfaces:
   1. The **exterior side** of the **foundation wall** up to six (6) inches below grade and the **top of the footing**.

B. **Related Requirements:**
   1. **Division 7** Section '**Self-Adhering Sheet Waterproofing**" for waterproofing of walls enclosing below-grade spaces (elevator pit, mechanical rooms, etc.).

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. **Material Certificates**: For each product, signed by manufacturers.

### 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

### 1.5 PROJECT CONDITIONS

A. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

B. **Ventilation**: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. **Cold-Applied, Emulsified-Asphalt Dampproofing**:
1. **Carlisle** Coatings & Waterproofing.
   a. Equal to: **Barricoat-R,** Roller Applied Waterproofing Membrane
2. **Henry** Company.
3. **Karnak** Corporation.
   a. Equal to: **83AF Fibered Dampproofing** (brush or spray appliled).
4. **Koppers** Industries, Inc.
5. **Meadows**, W. R., Inc.
6. **Sonneborn**, Div. of ChemRex, Inc.
7. **Tamms** Industries.
8. **Hydrocide 700B** BASF.

C. **Protection Course, Asphalt-Board Type**:
1. **Grace**, W. R. & Co.; Construction Products Div.
2. **Meadows,** W. R., Inc.
3. **Sonneborn**, Div. of ChemRex, Inc.
4. **Tamko.**
   a. Equal to: **Tamko TWH-1**

### 2.2 BITUMINOUS DAMPPROOFING

A. **Odor Elimination**: For interior and concealed-in-wall uses other than exterior face of inner wythe of cavity walls, provide dampproofing material warranted by manufacturer to be substantially odor free after drying for 24 hours under normal conditions.

B. **Cold-Applied, Emulsified-Asphalt Dampproofing**:
1. **Trowel Coats**: ASTM D 1227, Type II, Class 1.
2. **Fibered Brush and Spray Coats**: ASTM D 1227, Type II, Class 1.
3. **Brush and Spray Coats**: ASTM D 1227, Type III, Class 1.

### 2.3 MISCELLANEOUS MATERIALS

A. **Emulsified-Asphalt Primer**: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

B. **Asphalt-Coated Glass Fabric**: ASTM D 1668, Type I.

C. **Protection Course, Asphalt-Board Type**: Pre-molded, 1/8-inch- (3-mm-) thick, multi-ply, semi-rigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. **Begin dampproofing application** only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

B. **The Architect shall examine the installation** of dampproofing prior to backfilling. If backfilling occurs prior to Architects examination, Contractor shall remove backfill, at contractor's expense to allow for Architect's examination.

### 3.2 PREPARATION

A. **Protection of Other Work**: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. **Cleaning**: 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.

C. **Patching/Repair:** Apply patching compound to patch and fill tie holes, honeycombs, reveals, cracks, and other imperfections; cover with asphalt-coated glass fabric.

### 3.3 APPLICATION, GENERAL

A. **Comply with manufacturer's written recommendations** unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
   1. **Apply additional coats if recommended** by manufacturer or required to achieve coverages indicated.
   2. **Allow each coat of dampproofing to cure 24 hours** before applying subsequent coats.

B. **Apply dampproofing to footings and foundation walls** whether indicated or not.
   1. **Apply from finished-grade line to top of footing**, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
   2. **Extend 12 inches (300 mm) onto intersecting walls** and footings, but do not extend onto surfaces exposed to view when Project is completed.
   3. **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- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat required for embedding fabric is in addition to other coats required.

## 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. **On Concrete Foundations**: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. **On Backs of Concrete Retaining Walls**: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

## 3.5 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. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

## 3.6 CLEANING

A. **Remove dampproofing materials** from surfaces not intended to receive dampproofing.

**END OF SECTION**

# SECTION 07 1320

# SELF-ADHERING SHEET WATERPROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Modified bituminous sheet** waterproofing.
   2. **Protection** board.
   3. **Apply waterproofing** on the **foundation walls** at the following locations:
      a. Apply at the backfill side of the **elevator pit**.

B. **Related Sections** include the following:
   1. **Division 7** Section "**Joint Sealants**" for joint-sealant materials and installation.

### 1.3 SUBMITTALS

A. **Product Data**: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. **Shop Drawings**: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions. Provide project specific details for all conditions required to complete the Project.

C. **Samples**: For the following products:
   1. 12-by-12-inch (300-by-300-mm) square of waterproofing and flashing sheet.

D. **Installer Certificates**: Signed by manufacturers certifying that installers comply with requirements.

E. **Qualification Data**: For Installer.

F. **Warranties**: Special warranties specified in this Section.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: A firm that is approved or licensed by or acceptable to waterproofing manufacturer for installation of waterproofing required for this Project.

B. **Source Limitations**: Obtain waterproofing materials and protection course through one source from a single manufacturer.

C. **Preinstallation Conference**: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Deliver liquid materials** to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. **Store liquid materials** in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. **Remove and replace liquid materials** that cannot be applied within their stated shelf life.

D. **Store rolls** according to manufacturer's written instructions.

E. **Protect stored materials** from direct sunlight.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations**: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
   1. **Do not apply** waterproofing in snow, rain, fog, or mist.

B. **Maintain adequate ventilation** during preparation and application of waterproofing materials.

## 1.7 WARRANTY

A. **Special Manufacturer's Warranty**: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. **Failure includes**, but is not limited to, failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch (1.6 mm) in width.
   2. **Warranty Period**: **Five years** from date of Substantial Completion.

B. **Special Installer's Warranty**: Specified form, signed by Installer, covering Work of this Section, for warranty period of **three years**.
   1. **Warranty includes** removing and reinstalling protection board.

## PART 2 - PRODUCTS

### 2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. **Modified Bituminous Sheet**: 60-mil- (1.5-mm-) thick, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated to a 4-mil- (0.10-mm-) thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. **Carlisle** Coatings & Waterproofing Inc.; **CCW MiraDRI 860/861**.
   b. **Cetco; Envirosheet**.
   c. **Grace**, W. R. & Co.; **Bituthene 3000**.
   d. **Henry** Company; **Blueskin WP 200**.
   e. **Meadows**, W. R., Inc.; **SealTight Mel-Rol**.
   f. **Polyguard** Products; **Polyguard 650 Membrane**.

B. **Physical Properties**:
   a. **Tensile Strength**: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
   b. **Ultimate Elongation**: 300 percent minimum; ASTM D 412, Die C, modified.
   c. **Low-Temperature Flexibility**: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
   d. **Crack Cycling**: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
   e. **Puncture Resistance**: 40 lbf (180 N) minimum; ASTM E 154.
   f. **Hydrostatic-Head Resistance**: 150 feet (45 m) minimum; ASTM D 5385.
   g. **Water Absorption**: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
   h. **Vapor Permeance**: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

### 2.2 AUXILIARY MATERIALS

A. **General**: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. **Furnish liquid-type auxiliary materials** that comply with VOC limits of authorities having jurisdiction.

B. **Primer**: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.

C. **Surface Conditioner**: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. **Liquid Membrane**: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

E. **Substrate Patching Membrane**: Low-viscosity, two-component, asphalt-modified coating.

F. **Sheet Strips**: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.

G. **Mastic, Adhesives, and Tape**: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

H. **Metal Termination Bars**: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.

I. **Protection Course**: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
   1. **Thickness**: 1/4 inch (6 mm), nominal.
   2. **Adhesive**: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. **Verify that concrete has cured** and aged for minimum time period recommended by waterproofing manufacturer.
   2. **Verify that concrete is visibly dry** and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   3. **Proceed with installation** only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

A. **Clean, prepare, and treat substrates** according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. **Mask off adjoining surfaces** not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. **Remove grease**, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. **Remove fins**, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. **Prepare, fill, prime, and treat joints and cracks in substrates**. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

F. **Bridge and cover isolation joints** and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.
   1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. **Corners**: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
      a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.

H. **Prepare, treat, and seal vertical and horizontal surfaces** at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

## 3.3 MODIFIED BITUMINOUS SHEET WATERPROOFING APPLICATION

A. **Install** modified bituminous sheets according to waterproofing manufacturer's written instructions and according to recommendations in ASTM D 6135.

B. **Apply primer** to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. **Apply and firmly adhere sheets** over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation. Lap horizontal seams in the direction of water flow.
   1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

D. **Apply continuous sheets** over sheet strips bridging substrate cracks, construction, and contraction joints.

E. **Seal exposed edges** of sheets at terminations not concealed by metal counterflashings or ending in reglets with termination bars and liquid membrane product.

F. **Repair tears,** voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions. Seal edges of all patches with liquid membrane product.

G. **Install protection course** with butted joints over waterproofing membrane immediately. Tape seams to prevent displacement during backfilling.

H. **Correct deficiencies** in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

## 3.4 PROTECTION AND CLEANING

A. **Do not permit foot or vehicular traffic** on unprotected membrane.

B. **Protect waterproofing** from damage and wear during remainder of construction period.

C. **Clean spillage** and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION**

# SECTION 07 1800

# TRAFFIC COATINGS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes traffic coatings** for the following applications:
   1. Interior, mechanical room floors.

B. **Related Sections:**
   1. **Division 3** Section "**Cast-in-Place Concrete**" for concrete deck.
   2. **Division 5** Section "**Steel Deck**" for form deck/structural deck below slab to receive traffic coating.

### 1.3 SUBMITTALS

A. **Product Data**: For each product indicated.

B. **Shop Drawings**: Show extent of each traffic coating. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.

C. **Samples for Selection**: Manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of product indicated.

D. **Material Test Reports**: From a qualified independent testing agency indicating and interpreting test results for compliance of traffic coatings with requirements, based on comprehensive testing of current product formulations within the last three years.

E. **Material Certificates**: Signed by manufacturer certifying that traffic coatings comply with requirements, based on comprehensive testing of current product formulations within the last three years.

F. **Maintenance Data**: To include in maintenance manuals specified in Division 1. Identify substrates and types of traffic coatings applied. Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of traffic coatings.

### 1.4 QUALITY ASSURANCE

A. **Installer (Applicator) Qualifications**: An experienced applicator who has specialized in installing work similar in material, design, and extent to that indicated for this Project and who is certified by manufacturer.
   1. Certification: Written approval or license of applicator by traffic coating manufacturer.

B. **Source Limitations**: As follows:
1. Use traffic coatings of a single manufacturer.
2. Obtain primary traffic coating materials, including primers, from traffic coating manufacturer. Obtain secondary materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of type and from source recommended by traffic coating manufacturer.

C. **Fire-Test-Response Characteristics**: For traffic coatings as follows:
1. Fire-response testing was performed by UL, ITS, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Provide materials identical to those of traffic coatings tested according to ASTM E 108 for deck type and slopes indicated and that comply with requirements for roof-covering Class indicated.

D. **Preinstallation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
1. Before installing traffic coatings, meet with representatives of authorities having jurisdiction, manufacturer's technical representative, Owner, Architect, consultants, independent testing agency, and other concerned entities. Review requirements for traffic coatings. Notify participants at least seven days before conference.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels showing the following information:
1. Manufacturer's brand name.
2. Type of material.
3. Directions for storage.
4. Date of manufacture and shelf life.
5. Lot or batch number.
6. Mixing and application instructions.
7. Color.

B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations**: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of the substrate.

## 1.7 COORDINATION

A. Coordinate steel form deck type, finishing of concrete surface and other conditions that may affect performance of traffic coating.

## 1.8 WARRANTY

A. **General Warranty**: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Special Warranty**: Written warranty, signed by traffic coating manufacturer agreeing to repair or replace traffic coatings that do not comply with requirements or that deteriorate during the specified warranty period. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch (1.6 mm) in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.
   1. Deterioration of traffic coatings includes, but is not limited to, the following:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failures.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.

C. **Warranty Period**: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

A. **Physical Requirements**: Provide traffic coatings complying with ASTM C 957.

B. **Material Compatibility**: Provide primers; base, intermediate, and top coats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

## 2.2 TRAFFIC COATING

A. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Carlisle** Coatings & Waterproofing, Inc.
      a. Equal to: **CCW-5013 Deck Coating** System.
   2. **Karnak** Corporation.
   3. **Mameco** International, Inc.
   4. **Sonneborn**, Div. of BASF, Inc.

B. **Primer**: Manufacturer's standard factory-formulated primer recommended for substrate and conditions indicated.
   Material: **Urethane**.

C. **Base Membrane**: Shall be equal to CCW-501 single-component, VOC compliant, high adhesion, moisture cured, liquid polyurethane membrane and shall meet or exceed the following typical performance properties:

| Property | Typical Value | ASTM Method |
|---|---|---|
| Composition | Aromatic Urethane | |
| Solids by Weight | 85% | |
| Hardness, Shore A | 63 | D 2240 |
| Tensile Strength | 900 PSI | D 412 |
| Ultimate Elongation | 625% | D 412 |
| Tear Resistance | 150 lb/in | D 624 |
| Adhesion to Concrete | 30 PLI | D 903 |
| Low Temp. Flexibility | -650F | D 522 |

D. **Traffic-Resistant Top Coat**: Shall be equal to CCW-503 single component, VOC compliant, high tensile strength, abrasion-resistant and weather-resistant aliphatic elastomeric polyurethane and shall meet or exceed the following typical performance properties:

| Property | Typical Value | ASTM Method |
|---|---|---|
| Composition | Aliphatic Urethane | |
| Solids by Weight | 72% | |
| Hardness, Shore A | 94 | D 2240 |
| Tensile Strength | 4000 PSI | D 412 |
| Ultimate Elongation | 200% | D 412 |
| Tear Resistance, Die | 300 lb/in. | D 624 |
| Low Temp. Flexibility | -500F | D 522 |
| Weather Resistance | No Chalking at 2000 hrs. | G 53 |
| Water Permeability (system) | < 1.0 Perm | E 96 B |
| Abrasion Resistance (system) | < 50 mg. | C 501 |
| Fire Resistance (system) | Class A | U.L. 790 |

E. **Aggregate**: Uniformly graded washed silica sand of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.

1. **Spreading Rate**: As recommended by manufacturer for substrate and service conditions indicated, but not less than the following:
   a. Top Coat: 8 to 10 lb/100 sq. ft. (4 to 5 kg/10 sq. m).

## 2.3 MISCELLANEOUS MATERIALS

A. **Joint Sealants**: Multicomponent urethane sealant recommended in writing by manufacturer for substrate and joint conditions indicated and for compatibility with traffic coatings; complying with ASTM C 920, Type M, Class 25, Grade NS for sloping and vertical applications or Grade P for deck applications, and Use T where subject to traffic or Use NT elsewhere.

B. **Sheet Flashing**: 50-mil- (1.3-mm-) minimum, nonstaining sheet material recommended by manufacturer.

C. **Adhesive**: Manufacturer's recommended contact adhesive.

D. **Reinforcing Strip**: Manufacturer's recommended fiberglass mesh.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, with Applicator present, for compliance with requirements and for other conditions affecting performance of traffic coatings.
   1. For the record, prepare written report, endorsed by Applicator, listing conditions detrimental to performance.
   2. Verify compatibility with and suitability of substrates.
   3. Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed, after unsatisfactory conditions have been corrected, and after surfaces are dry.
   4. Verify that substrates are visibly dry and free of moisture. Test for moisture by by plastic sheet method according to ASTM D 4263.
   5. Application of coating indicates acceptance of surfaces and conditions.
   6. Perform adhesion tests of system, in presence of manufacturer's representative, before proceeding with work.

### 3.2 PREPARATION

A. **Clean and prepare substrates** according to manufacturer's written recommendations to produce clean, dust-free, dry substrate for traffic coating application.

B. Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.

C. **Concrete Substrates**: Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259. Do not acid etch.
   1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
   2. Remove concrete fins, ridges, and other projections.
   3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
   4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

### 3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written recommendations.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

## 3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and traffic coating manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

## 3.5 TRAFFIC COATING APPLICATION

A. **Application**: Apply traffic coating material according to ASTM C 1127 and manufacturer's written recommendations.
   1. Start traffic coating application in presence of manufacturer's technical representative.
   2. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft (9 sq. m).
   3. At Mechanical Penthouse Rooms and where shown on Drawings, apply traffic coatings to CMU walls to height of 4". Omit aggregate on vertical surfaces.

B. **Priming**:
   1. Stir each side separately to ensure that no separation has occurred then mix all of Part A with all of Part B. Use a mixing paddle in a slow speed drill motor. Mix 2 to 3 minutes until a homogenous blend is achieved. Allow 15 to 30 minute induction period before applying.
   2. Apply primer at a rate of 400 square feet per gallon. Avoid puddles or ponding the primer and do not apply primer over stripe coats.
   3. Allow primer to dry for 1 hour minimum, 8 hours maximum. Primer is sufficiently dry when it is somewhat tacky but will not transfer when touched. In the event coating is not applied within the maximum time, reprime.

C. **CCW-501 Base Membrane**: Apply in one uniform coat at the rate of one gallon minimum per 50 square feet or as needed in order to obtain a minimum thickness of 32 wet mils. Allow the base membrane to cure 16 to 48 hours.

D. **CCW-503 Top Coat**: Apply in one uniform coat at the rate of one gallon minimum per 100 square feet or as needed in order to obtain a minimum thickness of 16 wet mils. Immediately broadcast 30-65 mesh aggregate into the wet material at a rate of 8-10 lbs. per 100 square feet and backroll. Allow the membrane to cure 16 to 48 hours.

## 3.6 CURING AND PROTECTING

A. Cure traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.

B. Protect traffic coatings from damage and wear during remainder of construction period.

**END OF SECTION**

# SECTION 07 1900

# WATER REPELLENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes clear water-repellent coatings for** the following vertical and non-traffic horizontal surfaces:
   1. **Veneer** brick.
   2. **Exterior concrete masonry units** (unpainted and unglazed)**.**
   3. **Interior concrete masonry units** (unpainted and unglazed).
   4. **Stone masonry.**

B. **Related Sections** include the following:
   1. **Division 3** Sections for **concrete work** including floor sealers and curing agents.
   2. **Division 4** Sections for **masonry**.
   3. **Division 7** Section "**Joint Sealants**" for joint sealants.
   4. **Division 9** Section "**Painting**" for paints and coatings.

### 1.3 PERFORMANCE REQUIREMENTS

A. **Provide water repellents with the following properties** based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

B. **Masonry Sealer Requirements**:
   1. **Masonry Absorption**: Minimum 98 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
      a. **Brick**: ASTM C 67
      b. **Concrete Unit Masonry**: ASTM C 140.
   2. **Water-Vapor Transmission**: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
   3. **Water Penetration and Leakage through Masonry**: Maximum 98 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
   4. **Durability**: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
   5. **Permeability**: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.
   6. **Chloride-Ion Intrusion in Concrete**: Transportation Research Board, National Research Council's NCHRP Report 244, Series II tests.
      a. **Reduction of Water Absorption**: 80 percent.
      b. **Reduction in Chloride Content**: 80 percent.

## 1.4 SUBMITTALS

A. **Product Data**: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. **Samples**: Of each substrate indicated to receive water repellent, 12 inches square, with specified repellent treatment applied to half of each sample.

C. **Applicator Certificates**: Signed by manufacturer certifying that the applicator complies with requirements.

## 1.5 QUALITY ASSURANCE

A. **Applicator Qualifications**: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

B. **Source Limitations**: Obtain the **masonry sealer** and the **graffiti control** product from a single manufacturer.

## 1.6 TEST PANELS

A. **Field Samples**: Select multiple representative surfaces for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed and in accordance with provisions in this Section. Comply with application requirements of this Section.
   1. **Obtain Architect's approval of field samples** before applying water repellents.
   2. **Maintain field samples during construction** in an undisturbed condition as a standard for judging the completed Work.

B. **Clean test panel area** following substrate manufactures guidelines and recommended products for cleaning.

C. **After substrate has dried**, rilem tube testing shall be done by manufactures representative, to determine coverage rates.

D. **Before full-scale application**, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each water repellent to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.

E. **Apply water repellents** to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. A final rilem tube test shall be done to determine if desired finish has been accomplished. Do not begin full-scale application until test panels are inspected and approved by the Architect and the Manufacturer.

F. **Test Panel Requirements**:
1. **Size**: Minimum 4 feet by 4 feet each.
2. **Locations**: As determined by the Architect.
3. **Number:** As required to completely test each water repellent with each type of substrate to be protected.

## 1.7 PROJECT CONDITIONS

A. **Weather and Substrate Conditions**: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:
1. **Ambient temperature** is less than 40 deg F.
2. **Concrete surfaces** and mortar have cured for less than 28 days.
3. **Rain** or temperatures below 40 deg F are predicted within 24 hours.
4. **Application** is earlier than 24 hours after surfaces have been wet.
5. **Substrate is frozen** or surface temperature is less than 40 deg F.
6. **Windy condition exists** that may cause water repellent to be blown onto **vegetation** or surfaces not intended to be coated.

## 1.8 WARRANTY

A. **General Warranty**: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. **Special Warranty**: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.
1. **Warranty Period**: **5 years** from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified in Part 3 schedules to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and deisgn concept as expressed in the Contract Documents is not changed, as judged by the Architect.

## 2.2 WATER REPELLENTS

A. **Material Compatibility**: Provide primers, undercoats, and finish-coat materials 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.

B. **Material Quality**: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

1. **Proprietary Names**: Use of manufacturer's proprietary product names to designate colors 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.

C. **Silane/Siloxane Blends**: Consisting of silanes and siloxanes blended to achieve a particular penetration and protection on a specific substrate with total active ingredients by weight less than 15%.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **Clean substrate** of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

1. **Clay Brick Masonry**: Clean clay brick masonry per ASTM D 5703.

B. **Test for pH level**, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. **Protect adjoining work**, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. **Coordination with Sealants**: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. **Test Application**: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location that has been fully cleaned and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.

1. **Revisions of planned application**, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

### 3.2 APPLICATION

A. **Application rate shall be in accordance with manufacturers written recommendations** and in accordance with proper coverage rates for warranty requirements.

B. **Apply a heavy-saturation spray coating** of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

C. **Apply a second saturation spray coating**, repeating first application, **if called for** in the **Water Repellant Schedule** at the end of this section. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

D. **Apply** coatings on the **full height of the wall** unless otherwise indicated.

## 3.3 FIELD QUALITY CONTROL

A. **Manufacturer's Field Service**: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

## 3.4 CLEANING

A. **Protective Coverings**: Remove protective coverings from adjacent surfaces and other protected areas.

B. **Immediately clean water repellent from adjoining surfaces** and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

## 3.5 EXTERIOR WATER REPELLENT SCHEDULE

A. **General**: Provide the following systems for the various substrates, as indicated.
1. **MASONRY: 'Blok-Guard and Graffiti Control II'** as manufactured by **Prosoco**.
   a. **Vertical Applications**: Apply with a "wet-on-wet" application to a visibly dry and absorbent surface.
      1) Spray:
         (a) **Saturate**, "**wet-on-wet**" from the bottom up creating a 6"-8" rundown below the spray contact point. Avoid excessive overlapping.
         (b) **Let the first application penetrate** the masonry surface for 2 to 3 minutes. For heavily textured and porous surfaces, re-apply in the same saturating manner to ensure complete coverage of recessed surfaces.
         (c) **Immediately brush out runs** and drips to prevent build up.
2. **STONE: 'R-97'** as manufactured by **Cathedral Stone Products**.
   a. **Vertical Applications**: Apply with a "wet-on-wet" two coat application to a visibly dry and absorbent surface.
      1) Spray:
         (a) **Saturate surface until it starts to run**. Do not let first coat dry before applying second coat.

## 3.6 INTERIOR WATER REPELLENT SCHEDULE

A. **General**: Provide the following systems for the various substrates, as indicated.

1. **MASONRY: Enviroseal PBT** as manufactured by **BASF/Hydrozo.**

   a. Vertical Applications:

      1) **1st/2nd Coat** - apply per manufacturer's written recommendations at a rate of 200-250 aq. ft./gal. Runs or sags shall be immediately brushed out to even the coat.

**END OF SECTION**

# SECTION 07 2100

# BUILDING INSULATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
1. **Foundation wall** insulation (supporting backfill).
2. **Polyisocyanurate** board insulation for exterior walls.
3. **Concealed** building insulation.
4. **Fire safing** insulation.
5. **Sound attenuation** blankets.
6. **Spray-applied polyurethane** foam insulation.

B. **Related Sections**: The following Sections contain requirements that relate to this Section:
1. **Division 4** Section "**Unit Masonry Assemblies**" for foamed-in-place masonry cell insulation.
2. **Division 4** Section "**Unit Masonry Assemblies**" for installation of cavity wall insulation furnished by this Section.
3. **Division 7** Section "**Thermoplastic Membrane Roofing**" for insulation specified as part of roofing construction.
4. **Division 7** Section "**Fluid-Applied Air, Moisture and Vapor Barrier**" for air barriers over gypsum sheathing.
5. **Division 9** Section "**Gypsum Board**" and "**Gypsum Sheathing**" for insulation installed as part of metal-framed wall and partition assemblies.

### 1.3 SUBMITTALS

A. **General**: Submit each item in this Article according to the Conditions of the Contract and **Division 1** Specification Sections.

B. **Product Data**: Provide product data for each type of insulation product specified.

C. **Product Test Reports**: Provide product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

### 1.4 QUALITY ASSURANCE

A. **Single-Source Responsibility for Insulation Products**: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. **Fire-Test-Response Characteristics**: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. **Surface-Burning Characteristics**: ASTM E 84.
   2. **Fire-Resistance Ratings**: ASTM E 119.
   3. **Combustion Characteristics**: ASTM E 136.

C. **Mock-Ups**: Before installing building insulation, build a mockup in an area or room as directed by the Architect, for each insulation condition to be a standard for insulation installation. Mock-up to include batt insulation, rigid insulation, vapor barrier, conditions where insulation is covered with gypsum board and where insulation is to be left exposed such as above ceilings. Also provide a mock-up at the foundation insulation. The approved mock-up may remain a part of the permanent construction.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Protection**: Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. **Protect plastic** insulation as follows:
   1. **Do not expose to sunlight**, except to extent necessary for period of installation and concealment.
   2. **Protect against ignition at all times**. Do not deliver plastic insulating materials to Project site before installation time.
   3. **Complete installation** and concealment of plastic materials as rapidly as possible in each area of construction.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:
   1. **Extruded Polystyrene Board** Insulation:
      a. **Amoco** Foam Products Company.
      b. **DiversiFoam** Products.
      c. **Dow** Chemical Co.
      d. **Insulfoam** LLC.
      e. **UC Industries**, Inc.; Owens-Corning Co.
   2. **Glass-Fiber** Insulation:
      a. **CertainTeed** Corporation.
      b. **Knauf Fiber** Glass GmbH.
      c. **Owens-Corning** Fiberglas Corporation.
      d. **Johns Manville** Corporation.
   3. **Polyisocyanurate Board** Insulation:
      a. **Apache Products** Company.
      b. **Celotex** Corporation.
      c. **Hunter** Panels.
      d. **Johns Manville** Corporation.

4. **Spray-applied Polyurethane** Insulation:
   a. **Icynene** MD-C-200.
   b. **NCFI InsulBloc** 11-017
   c. **Dow CM** series.
   d. **BASF Comfort Foam** 178 Series.

## 2.2 INSULATING MATERIALS

A. **General:** Provide insulating materials that comply with requirements and with referenced standards.

B. **Extruded Polystyrene Board** Insulation (**Perimeter insulation below grade**): Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an **extrusion process** using hydrochlorofluorocarbons as blowing agent to comply with ASTM C 578 for type and with other requirements indicated below:
   1. **Type IV**, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density, unless otherwise indicated.
   2. **Surface-Burning Characteristics**: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
   3. **Recycled Content**: Not less than 50 percent blend of post-consumer and recovered polystyrene resins.
   4. **Thickness**: 2 inches minimum.

C. **Unfaced Mineral-Fiber Blanket Insulation** (Blankets without membrane facing): Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, **Type I**
   1. **Mineral-Fiber Type**: Fibers manufactured from glass.
   2. **Surface-Burning Characteristics**: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
   3. At **3 5/8" steel stud walls** provide **R-13** blankets, at **6" steel stud walls** provide **R-19** blankets and provide **R-38** blankets at **soffits**, **overhangs** and **roof exterior**. When used as a sound attenuation blanket, **provide thickness equal to the full thickness of the wall cavity.**

D. **Polyisocyanurate Board Insulation**: (**Cavity** walls, exterior insulation **above grade** and **furred CMU walls**) **ASTM C 1289**, **Type II**, **Class 2** (20 psi), with maximum flame-spread and smoke-developed indices of 25 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 1 1/2 inches (101 mm). Closed cell polyisocyanurate foam core bonded to a high performance coated glass facer.
   1. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
      a. **Manufacturer:** Hunter Panels.
      b. **Product:** Hunter Panels Xci CG.
   2. **Physical Properties (Foam Core):**
      a. Compressive Strength: ASTM D 1621; Type I; Grade 2, 20 psi (138 kPa) minimum and Grade 3, 25 psi (172 kPa).
      b. Dimensional Stability: ASTM D 2126, 2 percent linear change (7 days).
      c. Moisture Vapor Permeance: ASTM E 96, less than 1 perm (57.5ng/(Pa•s•m2)).

d. Water Absorption: ASTM C 209, less than 0.1 percent by volume.
e. Service Temperature: Minus 100 degrees to 250 degrees F (Minus 73 degrees C to 122 degrees C).
f. Resistance to Mold: ASTM D 3273 Passed (10).

3.

E. **Spray-Applied Polyurethane Insulation**: Medium-density, closed cell product conforming to:

1. **Thermal Resistance** (R-Value/inch): ASTM C518; **6.7** hr/sq ft/degree F/BTU, aged 90 days @ 140 deg. F.
2. **Air Permeance**: ASTM E283; Less than 0.02 l/m2/second for 75 Pa for 1 inch thickness.
3. **Water Vapor Transmission**: ASTM E96; 0.9 perms for 1.5 inches (38 mm) of material.
4. **Flame Spread and Smoke Developed Rating**: ASTM E84; <20/<400.
5. **Thermal Barrier**: The **spray applied foam insulation** must be separated from the interior of the building by an approved **thermal barrier**, such as 1/2-inch (min) gypsum wallboard installed using mechanical fasteners or on studs in accordance with the applicable code, or an **equivalent 15-minute thermal barrier** complying with the applicable code,
   a. **Ignition Barrier**: When the insulation is installed **within an attic space** where entry is made only for service of utilities, **an ignition barrier must be installed** in accordance with **IBC Section 2603.4.1.6**. The ignition barrier must be consistent with the requirements for the type of construction required by the applicable code and must be installed in a manner so that the foam plastic insulation is not exposed. The **ignition barrier** may be an **intumescent coating**.
   b. **Available manufacturers** of the **intumescent coating** include, but are not limited to, the following
      1) **FireFree 88**: Water-based intumescent coating; International Fire Resistant Systems, Inc.
      2) **SafeCoat Latex**: Latex-based intumescent coating; Magna Coatings Technology Inc.
      3) **Aldocoat 757**: Water-based acrylic coating; Aldo Products Company, Inc.
      4) **DC-315:** Intumescent paint; National Fireproofing, Inc.

## 2.3 FIRE SAFING INSULATION AND ACCESSORIES

A. **Slag-Wool-Fiber Board Safing Insulation**:

1. **Semirigid boards** designed for use as fire stop at openings between edge of slab and exterior wall panels and other locations as required for fire stopping.
2. **Boards** are to be produced by combining slag-wool fibers with thermosetting resin binders.
3. **Comply** with **ASTM C 612**, Type **IA** and **IB**.
4. **Density**: Nominal density of **4 lb/cu. ft**. (64 kg/cu. m).
5. **Safing to pass**: **ASTM E 136** for combustion characteristics; thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

B. **Caulking Compound**: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.

C. **Safing Clips**: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

## 2.4 AUXILIARY INSULATING MATERIALS

A. **Adhesive for Bonding Insulation**: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

## 2.5 INSULATION FASTENERS

A. **Adhesively Attached, Spindle-Type Anchors**: Plate welded to projecting spindle; capable of holding insulation, of thickness indicated, securely in position indicated with self-locking washer in place; and complying with the following requirements:
   1. **Plate**: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   2. **Spindle**: Copper-coated low carbon steel, fully annealed, 0.105 inches (2.67 mm) in diameter, length to suit depth of insulation indicated.

B. **Insulation-Retaining Washers**: Self-locking washers formed from 0.016-inch-(0.41-mm-) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. **Where spindles** will be **exposed to human contact** after installation, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

C. **Anchor Adhesive**: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

D. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Adhesively Attached, Spindle-Type Anchors**:
      a. **TACTOO** Insul-Hangers; AGM Industries, Inc.
      b. Spindle Type **Gemco Hangers**; Gemco.
   2. **Anchor Adhesives**:
      a. **TACTOO** Adhesive; AGM Industries, Inc.
      b. **Tuff Bond** Hanger Adhesive; Gemco.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates** and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected. The Architect shall examine the installation of the insulation prior to insulation being covered by other work. If insulation is covered prior to Architects examination, Contractor shall remove other work, at contractor's expense to allow for Architect's examination.

## 3.2 PREPARATION

A. **Clean substrates** of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

## 3.3 INSTALLATION, GENERAL

A. **Comply with insulation manufacturer's written instructions** applicable to products and application indicated.

B. **Install insulation** that is undamaged, dry, unsoiled, and has not been exposed at any time to ice 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. **Apply single layer of insulation** to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

## 3.4 INSTALLATION OF PERIMETER INSULATION (BELOW GRADE)

A. **On vertical surfaces**, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer. **Use full pieces** and set tight together without gaps.

## 3.5 INSTALLATION OF GENERAL BUILDING INSULATION (ABOVE GRADE)

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. **Seal joints** between closed-cell (non-breathing) foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. **Set vapor-retarder-faced** units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
   1. **Tape joints** and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
   2. **At locations where an exterior wall becomes an interior wall** due to another exterior wall intersecting it on the exterior side, extend the vapor retarder 36” past the intersection of the walls.

D. **Install mineral-fiber blankets** in cavities formed by framing members according to the following requirements:
   1. **Use blanket widths and lengths that fill cavities** formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. **Place blankets in cavities** formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. **Insulation** is to **extend from floor to deck**, typical.

E. **Install board insulation** on concrete or masonry 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. **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.
   3. **Where insulation will not be covered** by other building materials, apply capped washers to tips of spindles.
   4. Insulation is to extend from floor to deck, typical.

F. **Stuff glass-fiber loose-fill insulation** into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

## 3.6 INSTALLATION OF SAFING INSULATION

A. **Install safing** insulation to fill gap between edge of concrete floor slab and back of exterior spandrel panels on safing clips spaced as needed to support insulation, but not further apart than 24 inches (610 mm) o.c. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with calking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

## 3.7 PROTECTION

A. **General:** Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION**

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## SECTION 07 2729

## FLUID APPLIED AIR, WATER, AND VAPOR BARRIER

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Materials and installation for an air, water and vapor barrier membrane** assembly within exterior wall assemblies as indicated on Drawings. System is to stop passage of air through and around:
1. Joints between exterior walls and roof.
2. Joints between walls and foundations.
3. Seismic and expansion joints.
4. Openings and penetrations of window frames, door frames, storefront and curtainwall.
5. Piping, conduit, duct and other penetrations.
6. Masonry ties, screws, bolts and similar projections
7. All other air leakage pathways through opaque walls, including fascias, cornices, "eyebrow" projections and other areas of the building envelope.

B. **Related Sections:** The following sections contain requirements that relate to this Section:
1. **Division 1** Section "**Mock-up Requirements**" for coordination of air and moisture barrier into large scale, testable mock-up of exterior wall systems.
2. **Division 7** Section "**Joint Sealers**" for sealant materials and installation techniques.
3. **Division 9** Section "**Gypsum Sheathing**" for building sheathing.

### 1.3 DEFINITIONS

A. **Air, Water, and Vapor Barrier:** Air-tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
1. **Water Vapor Permeance**: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.
2. It is the intent of this specification that air and moisture barrier products shall be non-breathable. **Provide only "non-breathable" products.**

### 1.4 REFERENCES

A. **ASTM E 84** - Standard Test Method for Surface Burning Characteristics of Building Materials; 2007.

B. **ASTM E 2178** - Standard Test Method for Air Permeance of Building Materials; 2003.

## 1.5 SUBMITTALS

A. **Submittals prior to contract award:**
   1. Installer Certification: Submit written certification from manufacturer certifying that Installer is approved by manufacturer to install specified system. Provide copy of certification to Architect before award of work.
   2. Certification that air and vapor barrier systems are compatible with curtainwall and storefront systems and do not void or otherwise impact curtainwall and storefront warranties.
   3. Certification that air and vapor barrier systems are compatible with curtainwall and storefront sealant systems.
   4. Certification that air and vapor barrier systems are compatible with adjacent sealants and assemblies.
   5. Letter from the primary roofing manufacturer stating that the proposed application will comply with the Manufacturer's requirements in order to qualify the project for the specified guarantee.

B. **Product data** for each type of product specified. Include data substantiating that materials comply with requirements.

C. **Shop Drawings**: Locations and extent of air and vapor barrier and details of typical and project-specific conditions, as required to provide a complete and continuous system.

D. Manufacturer's **installation instructions.**

E. **Certification of compatibility** by manufacturer, listing all materials on the Project with which the product and accessories may come in contact.

F. Provide **evidence of licensing and certification** under the ABAA Quality Assurance Program.

## 1.6 QUALITY ASSURANCE

A. **Single-Source Responsibility:** Obtain product and accessories from single manufacturer.

B. **Installer Qualifications:**
   1. Specifically approved by manufacturer and experienced in application of product.
   2. Licensed and certified by Air Barrier Association of America (ABAA).
   3. Compliant with provisions of Owner's exterior commissioning program as outlined in Section 01 9115 "Facility Exterior Enclosure Commissioning".

C. **Pre-Installation/Construction Meetings**: Convene one week prior to commencing Work of this section, in accordance with Section 01 3100 - Project Management and Coordination.

D. **Field-Constructed Mock-Ups**: Prior to installation on Project, apply Product and Accessories on mock-up to verify details under shop drawing submittals, to demonstrate tie-ins with adjoining construction and other termination conditions and to become familiar with properties of materials in application.

E. **Mock-up: Building Envelope**

1. Mock-up shall conform to requirements of Division 1 Section "Building Enclosure Functional Testing Requirements."
2. Air and moisture barrier system shall be included in free-standing building envelope mock-up as shown on Drawings.
3. All air and moisture barrier work in envelope mock-up shall be performed by comparably skilled and experienced workers to those who will actually be performing the work for the Project
4. Install air and moisture barrier in accordance with design documents and manufacturer's installation instruction, including joints with all pertinent materials. Air and moisture barrier shall be installed as proposed for actual construction of building.
5. Air and moisture barrier system shall be removed and replaced with new if visual observation or testing demonstrates failure to conform to testing requirements or design intent.
6. Approved mockups shall be retained intact and without damage throughout the construction process. Remove and dispose of properly off Owner's property and in accordance with the Waste Management Plan at Substantial Completion or when so directed by Architect.

F. **Preconstruction Field-Adhesion Testing:** Before installing air, water, and vapor barrier, field test adhesion to Project joint substrates as follows:

1. Locate tests where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each kind of substrate indicated.
3. Notify Architect seven days in advance of dates and times when tests will be conducted.
4. Arrange for tests to take place with air, water, and vapor barrier manufacturer's technical representative present.
5. Perform tests in accordance with ASMT D4541 "Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers" or other method required by air, water, and vapor barrier manufacturer demonstrating conformance to product requirements listed below.
6. Report whether air, water, and vapor barrier or any barrier system components failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For adhesive failures, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Products not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use products that fail to adhere to joint substrates during testing.

## 1.7 WARRANTY

A. Should all applicable building components be products of the same manufacturer, p**rovide Carlisle NVELOP Plus** warranty, covering roofing, roof insulation, vapor retarder, and below grade waterproofing systems.

B. **Warranty Period: 20 years** from Substantial Completion.

## 1.8 FIELD CONDITIONS

A. **Do not apply** product or accessories **during rain.**

B. **Apply product** and accessories within approved ambient and substrate temperature range stated in Manufacturer's literature.

C. **Do not apply** product or accessories **over incompatible materials.**

## 1.9 PERFORMANCE REQUIREMENTS

A. **Exhibit no visible water leakage** when tested per ATM E331 and shall perform as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration.

B. **Perform as a vapor barrier**, installed on the predominantly warm side of the insulation.

C. **Solvent free**, have VOC content no greater than 30 grams per liter. Free of noxious odors.

D. **Product,** when applied at minimum 0.040 inch (40 mils) cured thickness, **shall meet the following requirements**:

| REQUIREMENT | RESULT |
|---|---|
| Air Permeance | Not more than 0.02 liters per second per square meter of area at 75 Pa pressure differential |
| Water Vapor Permeance | Not more than 0.1 Perm |
| Tensile Elongation | Not less than 500 percent |
| Low Temperature Flexibility | No cracking, 180 degree bend over 1-inch mandrel at minus 20 degrees F |
| Low-Temperature Crack Bridging | Withstand 10 cycles at minus 15 degrees F |
| Pull adhesion on HDPE film, concrete, concrete block and gypsum sheathing | Not less than 16 lb per square inch OR substrate failure |

# PART 2 - PRODUCTS

## 2.1 VAPOR RETARDER

A. **Air and Moisture Barrier**: Cold-fluid-applied, water-based polymer-modified asphalt waterproofing membrane.

1. **Basis of Design:** Contract Documents are based on products specified below to establish as standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   a. **Manufacturer:** BASF Corporation - Wall Systems.
   b. **Products:** Enershield-I.

2. **Acceptable Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
   a. **Carlisle** Coatings and Waterproof (CCW) Barritech S/R ; www.carlisle-ccw.com.
   b. **Henry** Company; Air Bloc 32MR; www.henry.com
   c. **BASF;** Enershield-I; www.wallsystems.basf.com
   d. **Tremco;** ExoAir120; www.tremcosealants.com

B. **Accessories**: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
   1. **Primer:** Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
   2. **Detail Flashing**: 40 mil thickness, fire-resistant self-adhering flashing consisting of foil-faced glass laminated with fire-resistant butyl adhesive.
   3. **Transition Membrane**: Pressure-sensitive, 90 mil composite membrane consisting of 60 mils un-cured EPDM laminated with 30 mils of synthetic rubber pressure-sensitive adhesive.
      a. Provide preformed corners at curtain wall corners.
   4. **Reinforcing Fabric**: Air-barrier manufacturer's glass-fiber-mesh tape.
   5. **Contact Adhesive:** Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
   6. **Mastic:** LM 800 XL solvent-based synthetic rubber

C. **Related Accessories**
   1. **Joint Sealant:** Product approved by Manufacturer. Shall conform to ASTM C 920 Type 1 or 2, Grade NS, Class 25 or 50.
   2. **Polyurethane Foam**: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Verify that surfaces and conditions** are clean and ready to accept the work of this section. **Do not proceed with installation until** unsatisfactory conditions have been corrected.

B. **Verify that air, water and vapor barrier product is compatible** with surfaces.

C. **Verify that wall assemblies are dried in**, such that water intrusion will not occur from above, behind or around the air barrier installation.

D. **Concrete shall be cured** for a minimum of seven days. It shall be smooth, with sharp protrusions such as form joints ground flush. Honeycomb and holes/cracks exceeding ¼ inch across shall be filled with grout or mortar.

E. **Surfaces shall be sound, dry and free of oil**, grease, dirt, excess mortar or other contaminants.

F. **Surfaces shall be supported and flush** at joints without large voids or sharp protrusions.

G. **Mortar joints shall be struck flush** and shall be free of voids exceeding ¼ inch across. Mortar droppings shall be removed from brick ties and all other surfaces accepting air barrier.

H. **Sheathing boards** shall be flush at joints, with gaps between boards according to building code and sheathing manufacturer's requirements. Sheathing boards shall also be securely fastened to the structure with proper fastener type, technique and spacing according to building code and sheathing manufacturer's requirements. Sheathing boards shall be repaired or replaced if inspection reveals moisture damage, mechanical damage or if sheathing boards have exceeded the exposure duration or exposure conditions as required by the sheathing manufacturer.

I. Plywood, OSB, lumber or pressure-treated **wood moisture conten**t, measured with a wood moisture meter in the core of the substrate, shall be **below 20 percent**.

J. **Inform Architect in writing of:**
1. **Cracks** in concrete and masonry.
2. **Gaps or obstructions** such as steel beams, angles, plates and projections which cannot be spanned or covered by Product or Accessories.
3. **Anticipated problems** applying product and accessories over substrate.

## 3.2 PREPARATION

A. **Remove** projections, protruding fasteners, and loose or foreign matter **that might interfere with proper installation**.

B. **Treat sheathing joints** with either:
1. Sheathing joint treatment.
2. Fill with joint sealant and strike flush.

C. **Prime sheathing** if required by air, water, and vapor barrier manufacturer to assure adherence of barrier product.

## 3.3 INSTALLATION

A. **Install materials in accordance with manufacturer's instructions.**

B. **Air, Water, and Vapor Barrier:** Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. **Coatings:**
1. Prepare substrate in manner recommended by coating manufacturer; fill and tape joints in substrate and between dissimilar materials.
2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors airtight.
3. Sprayed Coating: Install to thickness recommended by manufacturer.
4. Use self-adhesive sheet flashing to seal to adjacent construction and to bridge joints.

D. **Openings and Penetrations in Exterior Weather Barriers:**

1. Install self-adhesive flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
2. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using self-adhesive flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
3. At head of openings, install self-adhesive flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
4. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
5. Service and Other Penetrations: Form self-adhesive flashing around penetrating item and seal to weather barrier surface.

## 3.4 FIELD QUALITY CONTROL

A. Do not cover installed weather barriers until required inspections have been completed.

## 3.5 REPAIR AND PROTECTION

A. Protect from damage during application and remainder of construction period.

B. Inspect before covering. Repair or replace damaged material according to Manufacturer's instructions and drawings.

C. Product and accessories are not designed for permanent exposure. Cover with insulation or exterior cladding as soon as schedule allows.

D. Outdoor exposure of installed transition membrane shall not exceed 60 days

E. Outdoor exposure of installed product shall not exceed 30 days.

**END OF SECTION**

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## SECTION 07 4213

## METAL SOFFIT PANELS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Metal soffit** panels.
   2. **Provide components required for a complete soffit panel assembly** including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items

B. **Related Sections** include the following:
   1. **Division 7** Section "**Sheet Metal Flashing and Trim**" for flashings and other sheet metal work not part of metal wall panel assemblies.
   2. **Division 7** Section "**Joint Sealants**" for field-applied sealants not otherwise specified in this Section.

### 1.3 PERFORMANCE REQUIREMENTS

A. **General**: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. **Air Infiltration**: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

C. **Water Penetration**: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

D. **Structural Performance**: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
   1. **Wind Loads**: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure as indicated on Drawings.
   2. **Deflection Limits**: Engineer metal wall panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.
      a. Test Pressures: 150 percent of inward and outward wind-load design pressures.

E. **Seismic Performance**: Provide metal wall panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. **Thermal Movements**: Provide metal wall panel assemblies 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 joint sealants, 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 1.4 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. **Shop Drawings**: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
   1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
      a. Flashing and trim.

C. **Coordination Drawings**: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:
   1. Wall panels and attachments.
   2. Stud framing.
   3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.

D. **Samples for Selection**: For each type of metal wall panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

E. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
   1. Metal Wall Panels: Include reports for air infiltration, water penetration, and structural performance.

F. **Maintenance Data**: For metal wall panels to include in maintenance manuals.

G. **Warranties**: Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: An employer of workers trained and approved by manufacturer.

B. **Fabricator Qualifications**: Certified by metal-faced composite wall panel manufacturer to fabricate and install manufacturer's wall panel system.

C. **Source Limitations**: Obtain each type of metal wall panel through one source from a single manufacturer.

D. **Product Options**: Drawings indicate size, profiles, and dimensional requirements of metal wall panels and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. **Mockups**: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
1. Build mockup of typical corner wall panel; approximately 48 inches (1200 mm) square by full thickness, including insulation, supports, attachments, and accessories.
2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

## 1.7 PROJECT CONDITIONS

A. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. **Field Measurements**: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.
   1. **Established Dimensions**: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal wall panels without field measurements, or allow for field trimming of panels. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

## 1.8 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.9 WARRANTY

A. **Special Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: Two years from date of Substantial Completion.

B. **Special Warranty on Panel Finishes**: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. **Fluoropolymer Finish**: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. **Finish Warranty Period**: **20 years** from date of Substantial Completion.

C. **Special Weathertightness Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace metal wall panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. **Weathertight Warranty Period**: **5 years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, **but are not limited to**, the products specified.
   2. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, **but are not limited to**, the manufacturers specified.

### 2.2 PANEL MATERIALS

A. **Metallic-Coated Steel Sheet Pre-painted with Coil Coating**: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. **Zinc-Coated (Galvanized) Steel Sheet**: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
   2. **Surface**: Smooth, flat finish.
   3. **Exposed Finishes**: Apply the following coil coating, as specified or indicated on Drawings.
      a. **High-Performance Organic Finish**: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
         1) **Fluoropolymer Two-Coat System**: Manufacturer's standard **two-coat**, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat with color coat containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with physical properties and coating performance requirements of AAMA 621, except as modified below:
            (a) **Humidity Resistance**: 2000 hours.
            (b) **Water Resistance**: 2000 hours.

4. **Concealed Finish**: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. **Panel Sealants**:
1. **Sealant Tape**: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. **Joint Sealant**: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. **Butyl-Rubber-Based, Solvent-Release Sealant**: ASTM C 1311.

## 2.3 MISCELLANEOUS METAL FRAMING

A. **Steel Sheet Components, General**: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

B. **Fasteners for Metal Framing**: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## 2.4 MISCELLANEOUS MATERIALS

A. **Fasteners**: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
1. **Fasteners for Flashing and Trim:** Blind fasteners or self-drilling screws with hex washer head.
2. **Blind Fasteners**: High-strength aluminum or stainless-steel rivets.

B. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 METAL SOFFIT PANELS

A. **Basis of Design:** Contract Documents are based on product specifed below to establish a standard of quality. Other available manufacturers' products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in Contract Documents is not changed, as judged by the Architect.
1. **Manufacturer:** Berridge Manufacturing Company.
2. **Product:** Flush Seam Panel.

B. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers whose products may be incorporated in the Work include, but are not limited to, the following:
1. **Berridge** Manufacturing Co.; www.berridge.com.
2. **Centria**; www.centria.com
3. **Fabral**, Inc.; www.fabral.com.
4. **MBCI**; www.mbci.com.
5. **Morin** Corporation; www.morincorp.com.

C. **Properties:**
1. **Width:** 4" nominal
2. **Gauge:** 24 gauge. 40 k.s.i.
3. **Texture:** ***Smooth.***
4. Length: Factory formed to maximum length (40 feet).
5. **Finish:** Premium fluorocarbon coating produced with Kynar 500 or Hylar 5000 resin.
6. **Color:** As listed in the **Color Schedule** or if not listed then as selected by Architect from manufacturer's full range of colors.

## 2.6 ACCESSORIES

A. **Panel Accessories**: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. **Backing Plates**: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
2. **Closure Strips**: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
3. **Attachment: #8 x 1/2" TEKS screws** at maximum spacing of 6'-0" on center per local code requirement.

B. **Flashing and Trim**: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

## 2.7 FABRICATION

A. **General**: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.

B. **Fabricate metal wall panels** in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. **Sheet Metal Accessories**: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
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.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
   1. Examine wall framing to verify that studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
   2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
   3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. **Examine roughing-in** for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. **Proceed with installation** only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Install flashings** and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

B. **Install fasciae and copings** to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

C. **Miscellaneous Framing**: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

## 3.3 METAL SOFFIT PANEL INSTALLATION, GENERAL

A. **General**: Install panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal wall panels by torch is not permitted.
2. Shim or otherwise plumb substrates receiving metal panels.
3. Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.
4. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.
5. Install starter and edge trim before installing panels.
6. Remove protective strippable film prior to installation of roof panels.
7. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings. Install screw fasteners in predrilled holes. Locate and space fastenings in uniform vertical and horizontal alignment.
8. Do not allow panels or trim to come into contact with dissimilar materials.
9. Remove and replace any panels or components which are damaged beyond successful repair.
10. Install flashing and trim as metal wall panel work proceeds.
11. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

B. **Metal Protection**: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

C. **Joint Sealers**: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.

## 3.4 ACCESSORY INSTALLATION

A. **General**: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. **Install** components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

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 (3 m) with no joints allowed within 24 inches (600 mm) 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 (25 mm) deep, filled with mastic sealant (concealed within joints).

## 3.5 ERECTION TOLERANCES

A. **Installation Tolerances**: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

## 3.6 CLEANING AND PROTECTION

A. **Remove temporary protective coverings** and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. **After metal wall panel installation**, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. **Replace metal wall panels** that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

# SECTION 07 4243

# COMPOSITE METAL WALL PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. **Metal-faced composite wall panels, fabricated for installation**.

B. **Related Sections** include the following:
   1. **Division 5** Section "**Cold-Formed Metal Framing**" for installation of sheet metal strips coordinated with spacing of metal panel fasteners at exterior locations.
   2. **Division 7** Sections **related to membrane roofing** for wall caps and fascia furnished and warranted as part of the roofing system.
   3. **Division 7** Section "**Sheet Metal Flashing and Trim**" for flashings and **other sheet metal work** not part of metal wall panel assemblies.
   4. **This Section 07 4243** - **Composite Metal Wall Panels** shall provide components required for a **complete wall panel assembly** including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items.
   5. **Division 7** Section "**Joint Sealants**" for field-applied sealants not otherwise specified in this Section.
   6. **Division 9** Section "**Non-Load-Bearing Steel Framing**" for installation of sheet metal strips coordinated with spacing of metal panel fasteners at interior locations.

### 1.3 DEFINITION

A. **Metal Wall Panel Assembly**: Metal wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight system.

### 1.4 PERFORMANCE REQUIREMENTS

A. **General**: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. **Air Infiltration**: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

C. **Water Penetration**: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

D. **Structural Performance**: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
   1. **Wind Loads**: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure as indicated on Drawings.
   2. **Deflection Limits**: Engineer metal wall panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.
      a. Test Pressures: 150 percent of inward and outward wind-load design pressures.

E. **Seismic Performance**: Provide metal wall panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. **Thermal Movements**: Provide metal wall panel assemblies 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 joint sealants, 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 1.5 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. **Shop Drawings**: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Provide project specific details for all conditions required to complete the Project, including interface and coordination with adjoining construction. Distinguish between factory- and field-assembled work.
   1. **Accessories**: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
      a. Flashing and trim.

C. **Coordination Drawings**: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:
   1. Wall panels and attachments.
   2. Stud framing.
   3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.

D. **Samples for Selection**: For each type of metal wall panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

E. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
   1. **Metal Wall and Soffit Panels**: Include reports for air infiltration, water penetration, and structural performance.

F. **Maintenance Data**: For metal wall panels to include in maintenance manuals.

G. **Warranties**: Special warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: An employer of workers trained and approved by manufacturer.

B. **Fabricator Qualifications**: Certified by metal-faced composite wall panel manufacturer to fabricate and install manufacturer's wall panel system.

C. **Source Limitations**: Obtain each type of metal wall panel through one source from a single manufacturer.

D. **Product Options**: Drawings indicate size, profiles, and dimensional requirements of metal wall panels and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
   1. **Do not modify intended aesthetic effects**, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. **Mockups**: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. **Incorporate composite metal wall panels in building envelope mock-up** per Division 1 Section "Mock-up Requirements".
   1. Build mockup of typical corner wall panel including soffit; approximately 48 inches (1200 mm) square by full thickness, including insulation, supports, attachments, and accessories.
   2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
   3. Test mock-up in accordance with Division 1 Section "Building Enclosure Functional Testing Requirements".
   4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
   5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. **Preinstallation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels including installers of doors, windows, and louvers.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver components**, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. **Unload, store, and erect metal wall panels** in a manner to prevent bending, warping, twisting, and surface damage.

C. **Stack metal wall panels horizontally** on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. **Protect strippable protective covering on metal wall panels** from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

## 1.8 PROJECT CONDITIONS

A. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. **Field Measurements**: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.
   1. **Established Dimensions**: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal wall panels without field measurements, or allow for field trimming of panels. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

## 1.9 COORDINATION

A. **Coordinate metal wall panel assemblies with rain drainage work**, flashing, trim, and construction of studs, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.10 WARRANTY

A. **Special Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. **Failures include**, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. **Warranty Period**: **Two years** from date of Substantial Completion.

B. **Special Warranty on Panel Finishes**: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. **Fluoropolymer Finish**: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. **Finish Warranty Period**: **20 years** from date of Substantial Completion.

C. **Special Weathertightness Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace metal wall panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. **Weathertight Warranty Period**: **Five years** from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **In other Part 2 articles** where titles below introduce lists, the following requirements apply for product selection:
   1. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

## 2.2 PANEL MATERIALS

A. **Aluminum Sheet**: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy 5005 for anodic finishes, with temper as required to suit forming operations and structural performance required.

1. **Alternative alloys include the following**:
   a. **Alloy 5005**: H14, H16, H24, H26, H34, or H36 temper.
2. **Surface**: Smooth, flat finish.
3. **Exposed Finishes**: Apply the following coating, as specified or indicated on Drawings.
   a. **High-Performance Organic Finish**: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      1) **Fluoropolymer Two-Coat System**: Manufacturer's standard **two-coat**, thermocured system consisting of specially formulated inhibitive primer complying with AAMA 2605. **Color** to be selected by the Architect from the manufacturer's **full range of colors, including metallics.**
4. **Concealed Finish**: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. **Aluminum Extrusions**: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated.

C. **Panel Sealants**:

1. **Sealant Tape**: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. **Joint Sealant:** ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. **Butyl-Rubber-Based, Solvent-Release Sealant**: ASTM C 1311.

## 2.3 MISCELLANEOUS METAL FRAMING

A. **Steel Sheet Components, General**: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

B. **Fasteners for Metal Framing**: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## 2.4 MISCELLANEOUS MATERIALS

A. **Fasteners**: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
   1. **Fasteners for Wall Panels**: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   2. **Exposed Fasteners for Composite Panels**: Stainless steel.
   3. **Fasteners for Flashing and Trim**: Blind fasteners or self-drilling screws with hex washer head.
   4. **Blind Fasteners**: High-strength aluminum or stainless-steel rivets.

B. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 METAL-FACED COMPOSITE WALL PANELS

A. **General**: Provide factory-formed and -assembled metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
   1. **Core**: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
      a. **Flame-Spread Index**: 15 or less.
      b. **Smoke-Developed Index**: 105 or less.
   2. **Acceptable Products**: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and Division 1 Sections.
      a. **Alusuisse** Composites, Inc.; Alucobond.
      b. **Mitsubishi** Chemical America, Inc.; Alpolic.
      c. **Reynolds** Metals Company; Reynobond PE.
      d. **Centria;** Formabond II

B. **Aluminum-Faced Composite Wall Panels**: Formed with 0.020-inch- (0.50-mm-) thick, coil-anodized aluminum sheet facings.
   1. **Panel Thickness**: 0.157 inch (4mm).
   2. **Core**: Fire retardant.
   3. **Exterior Finish**: Custom color and gloss as selected by Architect.

C. **Attachment System Components**: Formed from material compatible with panel facing.
   1. Include manufacturer's standard perimeter extrusions with integral weather stripping, panel stiffeners, panel clips and anchor channels.

D. **Flashing and Trim**: Same material, finish, and color as facings of adjacent composite panels, unless otherwise indicated.

## 2.6 ACCESSORIES

A. **Wall Panel Accessories**: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. **Closures**: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
2. **Backing Plates**: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. **Closure Strips**: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. **Flashing and Trim**: Formed from 0.0179-inch- (0.45-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

## 2.7 FABRICATION

A. **General**: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.

B. **Fabricate metal wall panels** in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. **Metal-Faced Composite Wall Panels**: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.

1. **Fabricate panels with sharply cut edges**, with no displacement of face sheets or protrusion of core material.
2. **Dimensional Tolerances**:
   a. **Length**: Plus 0.375 inch (9.5 mm).
   b. **Width**: Plus 0.188 inch (4.8 mm).
   c. **Thickness**: Plus or minus 0.008 inch (0.2 mm).
   d. **Panel Bow**: 0.8 percent maximum of panel length or width.
   e. **Squareness**: 0.2 inch (5 mm) maximum.

D. **Sheet Metal Accessories**: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

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.
2. **Seams for Other Than Aluminum**: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. **Sealed Joints**: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. **Conceal fasteners** and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. **Fabricate cleats** and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
   a. **Size**: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.8 FINISHES, GENERAL

A. **Comply** with **NAAMM's "Metal Finishes Manual for Architectural and Metal Products**" for recommendations for applying and designating finishes.

B. **Protect mechanical and painted finishes** on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. **Appearance of Finished Work**: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. **Examine wall framing** to verify that studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. **Examine solid wall sheathing** to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. **For the record**, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. **Examine roughing-in for components** and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. **Proceed with installation** only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Install flashings** and other sheet metal to comply with requirements specified in **Division 7** Section "**Sheet Metal Flashing and Trim**."

B. **Install fascia** and copings to comply with requirements specified in **Division 7** Section "**Sheet Metal Flashing and Trim**."

C. **Miscellaneous Framing**: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.
   1. **Soffit Framing**: Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

## 3.3 METAL WALL PANEL INSTALLATION, GENERAL

A. **General**: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Field cutting of metal wall panels by torch is not permitted.
   2. Shim or otherwise plumb substrates receiving metal wall panels.
   3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
   4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
   5. Install screw fasteners in predrilled holes.
   6. Locate and space fastenings in uniform vertical and horizontal alignment.
   7. Install flashing and trim as metal wall panel work proceeds.
   8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   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-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
   11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. **Fasteners**:
   1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. **Metal Protection**: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

D. **Joint Sealers**: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.

## 3.4 METAL-FACED COMPOSITE WALL PANEL

A. **General**: Install attachment system required to support wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.

B. **Clip Installation**: Attach panel clips to supports at each wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.

1. Seal penetrations of air, water, and vapor barrier to maintain functional performance of barrier system.
2. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 7 Section "Joint Sealants."

C. **Track-Support Installation**: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.

1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
4. Do not apply sealants to joints, unless otherwise indicated on Drawings.

D. **Metal Soffit Panels**: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

## 3.5 ACCESSORY INSTALLATION

A. **General**: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

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 (3 m) with no joints allowed within 24 inches (600 mm) 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 (25 mm) deep, filled with mastic sealant (concealed within joints).

## 3.6 ERECTION TOLERANCES

A. **Installation Tolerances**: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

## 3.7 CLEANING AND PROTECTION

A. **Remove temporary protective coverings** and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. **After metal wall panel installation**, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. **Replace metal wall panels** that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

# SECTION 07 5416

# ETHYLENE INTERPOLYMER (KEE) ROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Section Includes**:
1. **Mechanically fastened KEE membrane** roofing system.
2. Roof **insulation.**

B. **Related Sections:**
1. **Division 6** Section "**Miscellaneous Carpentry**" for wood nailers, curbs, and blocking.
2. **Division 7** Section "**Preparation for Re-Roofing**" for removal of existing roofing on original Stromberg building.
3. **Division 7** Section "**Building Insulation**" for insulation beneath the roof deck.
4. **Division 7** Section "**Polyvinyl-Chloride (PVC) Roofing**" for alternative roofing system - Contractor may use either KEE or PVC roofing, provided warranties, serviceability, and other features are equivalent.
5. **Division 7** Section "**Sheet Metal Flashing and Trim**" for metal roof penetration flashings, flashings, and counterflashings.
6. **Division 7** Section "**Joint Sealants**" for joint sealants, joint fillers, and joint preparation.
7. **Division 22** Section "**Storm Drainage Piping Specialties**" for roof drains.

### 1.3 DEFINITIONS

A. **Roofing Terminology:** See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

### 1.4 PERFORMANCE REQUIREMENTS

A. **General Performance:** Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. **Material Compatibility:** Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. **Roofing System Design:** Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. **FM Approvals Listing:** Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approval markings.
   1. Fire/Windstorm Classification: **Class 1A-90**
   2. Hail Resistance: **MH.**

E. **Energy Performance:** Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

## 1.5 ACTION SUBMITTALS

A. **Product Data:** For each type of product indicated.

B. **Shop Drawings:** For roofing system. Include plans, elevations, sections, details, and attachments to other work.
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
   5. Provide project-specific details for all conditions required to complete the project, coordinated with adjacent construction.

C. **Samples for Verification:** For the following products:
   1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
   2. Roof insulation.
   3. Walkway pads.
   4. Metal termination bars.
   5. Battens.
   6. Six insulation fasteners of each type, length, and finish.
   7. Six roof cover fasteners of each type, length, and finish.

## 1.6 INFORMATIONAL SUBMITTALS

A. **Qualification Data:** For qualified Installer and manufacturer.

B. **Manufacturer Certificates:** Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.

C. **Product Test Reports:** Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

D. **Research/Evaluation Reports:** For components of membrane roofing system, from the ICC-ES.

E. **Field quality-control reports.**

## 1.7 CLOSEOUT SUBMITTALS

A. **Maintenance Data:** For roofing system to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
   1. Manufacturer must be **listed in NRCA's low slope roofing materials guide.**
   2. Manufacturer must have a **10-year successful history** as a roofing manufacturer.
   3. The **system** must have a **five year successful history.**
   4. Manufacturer must show **documented proof of how they plan to meet warranty obligations**. Must be provided in contractor's submittal package.
   5. Manufacturer must have a **certified installer/contractor program**. This program must include continuing education for the contractor.
   6. **Contractor must submit a pre-installation notice** signed by an authorized representative of the manufacturer prior to start of any work. This will include confirmation that the membrane and all accessories being used meet requirements of specification. This will also include confirmation that the scope of work is in accordance with published technical data as per manufacturer. This also includes confirmation that a warranty has been requested and will be issued on the DFCM manufacturer warranty form at the completion of roofing. This document must be included in contractor's submittal package.
   7. Manufacturer must have a **history of meeting Warranty** obligations.
   8. Manufacturer shall **release all inspection reports** concerning warranted roof system to the Contractor to submit to project Architect.

B. **Installer Qualifications**: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Furnish 24 hour emergency contact number for Owner's use.
   1. Firm must have a minimum of **5 years experience** installing roofing system.
   2. Contractor must be **legally licensed** to perform roofing work in the State of Utah and **carry liability insurance** as required by State of Utah law.
   3. Firm must document **continuing education for the foreman** that will daily oversee the work on the roofing system. A minimum of 12 hours per year is required.
   4. **On-site foreman** must be able to **clearly communicate** with building Owner/occupants.

C. **Source Limitations:** Obtain components including fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. **Exterior Fire-Test Exposure:** ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. **Preinstallation Roofing Conference:** Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. **Deliver roofing materials to Project site** in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. **Store liquid materials** in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. **Protect roof insulation materials** from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. **Handle and store roofing materials** and place equipment in a manner to avoid permanent deflection of deck.

## 1.10 PROJECT CONDITIONS

A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.11 WARRANTY

A. Contractor to use Owner's DFCM Forms attached to this section.

B. **Special Warranty:** DFCM customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
   1. **Special warranty includes** membrane roofing, base flashings, roof insulation, fasteners, substrate board, roofing accessories, and other components of membrane roofing system.
   2. Warranty Period: **20 years** from date of Substantial Completion.

C. **Special Project Warranty:** Submit roofing Installer's DFCM warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
   1. Warranty Period: **5 years** from date of Substantial Completion.

D. **Warranty Sign:** Provide a metal sign with vinyl lettering with the following information:

**CAUTION**

This roof is under warranty until (insert year) with (insert manufacturer). All access is to be restricted without facilities manager's permission & log entry. Repair work if necessary should be performed only by an authorized applicator. For leak repairs, contact (insert manufacturer) @ (insert manufacturer warranty claim department phone number) and provide them with warranty number. Questions regarding this roof or any potential work pertaining to this roof, please contact DFCM @ 801-538-3018.

| | |
|---|---|
| Warranty #: | Roofing Contractor: |
| Warranty Type: | Contractor Telephone #: |
| Installation Date: | Contractor Address: |
| Manufacturer's Address: | Roof Membrane Type: |

   1. Install signs at all roof access points.
   2. Signs shall be minimum 20 gage metal, with rounded corners, no larger than 10 x 14 inches, long dimension horizontal.

## PART 2 - PRODUCTS

### 2.1 KEE MEMBRANE ROOFING

A. **KEE Sheet**: ASTM D 6754, fabric reinforced. Membrane must be manufactured by the company supplying the warranty **(no private labeling)** with a minimum 20 yr successful track record.
   1. **Acceptable Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and Division 1 Sections.
      a. Flex Membranes International, Inc.; Flex MF/R Plus 60.
      b. Seaman Corporation; Fibertite.
      c. Tremco Incorporated; TPA.
   2. **Thickness:** 60 mils (1.52 mm), nominal.
   3. **Exposed Face Color:** White.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. **General:** Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. **Sheet Flashing:** Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as KEE sheet membrane.

C. **Slip Sheet:** Manufacturer's standard, of thickness required for application.

D. **Metal Termination Bars:** Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. **Metal Battens:** Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

F. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

G. **Miscellaneous Accessories:** Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

## 2.3 SUBSTRATE BOARDS

A. **Substrate Board:** ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Georgia-Pacific Corporation; Dens Deck.
      b. Temple-Inland; GreenGlass.
   2. Any product used shall be approved by the roofing system manufacturer and authorized as part of their comprehensive warranty.

B. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

## 2.4 ROOF INSULATION

A. **General:** Preformed roof insulation boards manufactured or approved by KEE membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
   1. Total System R value of **R30 minimum** predicated upon Long Term Thermal Resistance Criteria (LTTR) of R6 per inch.
   2. Insulation shall be included in roofing manufacturer's 20 year warranty.

B. **Polyisocyanurate Board Insulation:** ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. **Tapered Insulation:** Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. **Provide preformed saddles**, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.5 INSULATION ACCESSORIES

A. **General:** Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

## 2.6 WALKWAYS

A. **Flexible Walkways:** Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Clean substrate** of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. **Prevent materials from entering and clogging roof drain**s and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. **Prevent materials from spilling** or migrating onto surfaces of other construction.

D. **Complete terminations and base flashings** and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

## 3.3 SUBSTRATE BOARD

A. **Install substrate board** with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
   2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

## 3.4 INSULATION INSTALLATION

A. **Coordinate installing membrane roofing system components** so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. **Comply with** membrane roofing system and insulation **manufacturer's written instructions** for installing roof insulation.

C. **Install tapered insulation** under area of roofing to conform to slopes indicated.

D. **Install insulation** under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
   1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. **Trim surface of insulation** where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. **Install insulation with long joints of insulation in a continuous straight line** with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. **Mechanically Fastened Insulation:** Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
   2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

## 3.5 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. **Mechanically fasten membrane roofing** over area to receive roofing and install according to roofing system manufacturer's written instructions.
   1. For in-splice attachment, install membranes roofing with long dimension perpendicular to steel roof deck flutes.

B. **Start** installation of membrane roofing **in presence of roofing system manufacturer's technical personnel.**

C. **Accurately align membrane roofing** and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. **Mechanically fasten** membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply membrane roofing with **side laps shingled with slope** of roof deck where possible.

F. **In-Seam Attachment:** Secure one edge of KEE sheet using fastening plates or metal battens centered within membrane seam and mechanically fasten KEE sheet to roof deck.

G. **Seams:** Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
   2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. **Spread sealant bed** over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

I. **Install membrane roofing and auxiliary materials** to tie in to existing roofing to maintain weathertightness of transition[ and to not void warranty for existing membrane roofing system].

## 3.6 BASE FLASHING INSTALLATION

A. **Install sheet flashings** and preformed flashing accessories and adhere to substrates **according to membrane roofing system manufacturer's written instructions.**

B. **Coordinate roof membrane flashing system with air, water and vapor barrier system.** Provide continuity of barrier plan at perimeters and transitions.

C. **Apply bonding adhesive** to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

D. **Flash penetrations** and field-formed inside and outside corners with cured or uncured sheet flashing.

E. **Clean seam areas**, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

## 3.7 WALKWAY INSTALLATION

A. **Flexible Walkways:** Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

## 3.8 FIELD QUALITY CONTROL

A. **Testing Agency:** Engage a qualified testing agency to perform tests and inspections.

B. **Final Roof Inspection:** Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
   1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
   2. Schedule final inspection to allow attendance of DFCM roofing program manager, Owner's representative, and Architect.

C. **Repair or remove and replace components** of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. **Additional inspections,** at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.9 PROTECTING AND CLEANING

A. **Protect membrane roofing system** from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. **Correct deficiencies** in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. **Clean overspray and spillage** from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

## 3.10 WARRANTY FORMS - DFCM

**END OF SECTION**

# WARRANTY FOR SINGLE PLY ROOFING

WHERE AS,_____(manufacture name), a corporation whose address is, _____ hereinafter called the Manufacturer, has manufactured and sold and caused to have applied, pursuant to the specifications and inspection, the necessary roofing materials to construct a PVC, TPO, EPDM or other single ply roof of approximately _____square feet and associated roof flashing of approximately _____ linear feet on the building described below:

OWNER: STATE OF UTAH

Owner:State of Utah

DFCM Project Number:_____

Building Name:_____

Location:_____

Date of Acceptance of Roofing:_____

Manufacturer Address:_____

Manufacturer's Warranty No:_____

Phone Number for Warranty Services:_____

Roofing Contractor Name:_____

Roofing Contractor Address:_____

AND WHEREAS, by careful examination of said roof by the Manufacturer's representative, it has been determined that roofing materials have been applied in conformance with Manufacturer's specifications.

AND WHEREAS, Manufacturer represents and wishes to warranty, subject to the limits stated herein, that its roofing when so applied is effectively watertight for a period of twenty (20) years despite normal wear and tear by the elements, as well as guaranteeing it against defects in workmanship or materials.

NOT withstanding any other provision herein, this warranty shall not cover damages related to winds in excess of _____ miles per hour

NOW THEREFORE, said Manufacturer warranties to the said Owner that, as set forth below, during a period of twenty (20) years from the date of acceptance of said single-ply roofing described above, Manufacturer will at its own expense, make or cause to be made, any repairs that may be necessary, as a result of defects in workmanship or materials supplied by the Manufacturer which results in leaks or of normal wear and tear by the elements which results in leaks, and will maintain said roof in water tight condition free from all leaks arising from such causes. For purposes of this warranty, damage to the roof caused by any unusual natural phenomena shall not be deemed to be "normal wear and tear by the elements".

INCLUSIONS: This Warranty does cover, and Manufacturer shall be liable for the following:

1. Roofing membrane, membrane flashings, metal flashings, mechanical fastening system, anchors, adhesives, seaming materials, slip sheets, fabrics, insulations, under payments, and accessories furnished by the Manufacturer as incorporated into the roof membrane system.

2. Vapor barriers, insulations and / or materials furnished by the Manufacturer or approved to be incorporated into the roof membrane assembly and such damage as may result from failure of these materials.

3. Repair of splits, breaks, cracks, and seam failures in membrane system.

4. Leaks from failure in material or workmanship.

EXCLUSIONS: This Warranty does not cover, and Manufacturer shall not be liable for the following:

1. Metal work, including metal counter flashings, not a part of the roof membrane system and such damage as may result from application of these materials;

2. Any damage to the roof caused by structural defect in, or failure of, the building or defects in, or failure of, any structural roof deck, or other sheathing materials, used as the base over which the roof and roof insulation is applied;

3. Roof damage from special chemical conditions not disclosed to Manufacturer;

4. Any damage to the building or contents thereof, except replacement of damaged roof insulation and vapor barrier as noted under "INCLUSION" above;

5. Damage due to unauthorized alterations to roofing system.

6. Damage to the roof due to mechanical abrasion or abuse not caused by the Manufacturer.

7. Damage or failure directly caused by the re-use of existing material. (re-roof)

8. Reasonable care and maintenance will be the responsibility of the owner.

INSPECTION AND REPAIR: During the term of this Warranty, Manufacturer, its agents or employees, shall have free access to the roof during regular business hours. Upon verbal notice by Owner to Manufacturer within four days of the discovery of any leaks in the roofing system, or need of repair of roof, the Manufacturer shall have ten (10) days to inspect the roof. Following such inspection:

1. Manufacturer, at its own expense shall make such repairs as are required by this warranty.

2. In case owner or his agent has verbally notified Manufacturer that repairs are required and such repairs are not covered by the Warranty (including repairs required by owner's alteration, extension or addition to the roof) Manufacture, after having obtained Owner's consent thereto, in writing, shall make or cause to be made, such repairs at Owner's expense in accordance with specifications and procedures as established by Manufacturer and this warranty shall thereupon remain in effect for the un-expired portion of its original term. If Owner fails to so consent or if repairs are made by one other than the Manufacturer's authorized designee, this Warranty with respect to such area shall be automatically terminated.

3. In the event the (1) Owner notifies Manufacturer and has confirmed the need of repair of roof and (2) Manufacturer is unable to promptly inspect and repair same, and (3) an emergency condition exists which requires prompt repair in order to avoid substantial damage to owner, then owner may make such temporary repairs as may be essential and any such action shall not be a breach of the provision of this Warranty. Owner will bear emergency repair expenses.

INSPECTION SERVICE: Manufacturer agrees to re-inspect the completed roof not earlier than 18 nor later than 24 months after completion of the roofing, and if it is determined that there are defects in the roofing, then Manufacturer shall make, or cause to be made at its own expense, such repairs as are necessary to remedy said defects within the scope of its responsibility under the terms of this Warranty.

IN WITNESS WHEREOF, Manufacturer has caused this instrument to be signed and sealed by its duly authorized officer this day of _____.

BY: _____

TITLE: _____

CORPORATION: _____

SEAL:

Project Manager Approval _____
Division of Facilities Construction and Management
Risk I.D. _____

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# CONTRACTOR ROOFING WARRANTY

WHEREAS: _____

Of (Address): _____ (Phone): _____

Herein called the "Roofing Contractor," has performed roofing and associated ("Work") on the following project:

Owner: State of Utah

Agency: _____

Name of Building: _____

DFCM Project Number: _____

Address: _____

Description of Work: _____

Date of Acceptance: _____

Warranty Period: 5 Years

Date of Expiration: _____

AND WHEREAS Roofing Contractor has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for said designated Warranty Period.

NOW THEREFORE Roofing Contractor hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period, Roofing Contractor will at his own cost and expense, promptly make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective Work, and as are necessary to maintain said Work in watertight condition. In addition to making the Work watertight, the Roofing Contractor shall promptly remove and/or repair blisters, ridges, flashings, splits and other irregularities which in the opinion of the Roofing Manufacture's technical representative do not conform to acceptable roofing practices and conditions. These repairs shall be made promptly and to the satisfaction of the Roofing Manufacturer's technical representative. Upon notice of Owner to Roofing Contractor, Contractor agrees to make the necessary leak repairs according to manufacturer's specifications within five business days from written notice given by DFCM.

This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to Work and other parts of the building, and to building contents, not caused by the act or negligence of Contractor and caused by: a) lightning, windstorm in excess of manufacturer's specifications; b) fire; c) failure of roofing system substrate including cracking settlement, excessive deflection, deterioration, and decomposition; d) faulty construction of parapet walls, copings, chimneys, skylights, vents, and equipment supports, not part of contractors work and e) activity on roofing by others including construction contractors, maintenance personnel, other persons, and animals whether authorized or unauthorized by Owner, but only to the extent any of the above exclusions are not due to the failure of the Roofing Contractor to meet all required specifications and the customary practices of the performing the work. When Work has been damaged by any of the foregoing causes, Warranty shall be suspended until such damage has been repaired by Roofing Contractor, and until cost and expense thereof has been paid by DFCM or by another responsible party so designated.

2. The Roofing Contractor is responsible for damage to Work covered by this Warranty, and is liable for consequential damages to building or building contents, resulting from leaks or faults or defects of Work that are related to Roofing Contractor's failure to meet.

3. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing Contractor or anyone not authorized by Roofing Contractor, including cutting, patching and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void upon date of said alterations, but only to extent said alterations affect Work covered by this Warranty. If Owner engages Roofing Contractor to perform said alterations, Warranty shall not become null and void, unless Roofing Contractor, prior to proceeding with said Work, shall reasonably claim that said alterations would damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.

4. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void upon date of said change, but only to extent said change affects Work covered by this Warranty.

5. The DFCM shall notify Roofing Contractor of observed, known or suspected leaks, defect or deterioration, and shall afford reasonable opportunity for Roofing Contractor to inspect Work, and to examine evidence of such leaks, defects or deterioration.

This Warranty is recognized to be the only Warranty of Roofing Contractor on said Work, and is in addition to the Roofing Warranty furnished by the Roofing Manufacturer, and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to it in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Contractor of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with DFCM or a subcontract with DFCM's General Contractor.

Any modification to the terms and conditions of this document will be submitted to the Attorney General's Office for investigation/prosecution.

IN WITNESS THEREOF, this instrument has been dully executed this

Day of , 20

Signed by Roofing Contractor by:

Roofing Contractor

Business Address

Signature & Printed Name

Title

Cosigned by General Contractor by:

General Contractor

Business Address

Signature & Printed Name

Title

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DFCM Roofing History Record
Single Ply Roofing

State Building #

DFCM Project #

Facility Name:

Building Name and Address:

Roof Section Description:

Roofing Contractor Name and Address:

Sub-contractors:

Roof System manufacture:

Installation Date:

Warranty Information:
Manufacture:

Contractor:

Roof Area (sq./ft.)

Building Use:

Height above Ground:

Access to Roof Area: Ladder_____ Roof Hatch_____ Stairs_____

Roof System Information

New Construction:_____ Re-Roof:_____ Old Roof Removed: Yes_____ No_____

Comments:_____

Deck Type: Slope:

Insulation:

| | | | |
|---|---|---|---|
| Layer #1 | Manufacture: | Thickness: | Attachment: |
| Layer #2 | Manufacture: | Thickness: | Attachment: |
| Layer #3 | Manufacture: | Thickness: | Attachment: |

Taper Explain:_____

System Type: PVC_____ EPDM_____ HYPALON_____ CSPE_____ TPO_____

Other_____

Field Sheet Description: Manufacture_____ Brand Name_____Mils_____
Attachment_____ Color_____ Reinforcement_____

Comments_____

Flashing Sheet: Manufacture_____ Brand Name_____Mils_____
Attachment_____ Color_____ Reinforcement_____

Comments_____

Separation Sheet: Manufacture_____ Brand Name _____

Drainage:

Internal Roof Drains____ Perimeter Gutter____ Internal Gutter____ Scuppers____

Primary:

Manufacture: Size: Quantity:

Overflow:

Manufacture: Size: Quantity:

Details:

Walls:_____

Edge:_____

Expansion Joints:_____

Walkways:_____

Other:_____

Roof Top Equipment:

| | | | |
|---|---|---|---|
| Mechanical: | Unit Types:_____ | Curb Types:_____ | Quantity_____ |
| Fans/Vents: | Unit Types:_____ | Curb Types:_____ | Quantity_____ |
| Other: | Unit Types:_____ | Curb Types:_____ | Quantity_____ |

Pipe Penetrations:

| | | |
|---|---|---|
| 1" | Quantity:_____ | Flashing Type:_____ |
| 1 ½ " | Quantity:_____ | Flashing Type:_____ |
| 2" | Quantity:_____ | Flashing Type:_____ |
| 3" | Quantity:_____ | Flashing Type:_____ |
| 4" | Quantity:_____ | Flashing Type:_____ |
| 5" | Quantity:_____ | Flashing Type:_____ |
| 6" | Quantity:_____ | Flashing Type:_____ |
| Other | Quantity:_____ | Flashing Type:_____ |

Additional Comments or Drawings:_____
_____
_____
_____
_____
_____

DFCM USE ONLY

State building #_____ Vendor ID_____

Installation year _____ Roof type _____

Manufacturer _____ Deck type _____

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# SECTION 07 5421

# POLYVINYL-CHLORIDE (PVC) ROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Section Includes**:
1. **Mechanically fastened** PVC membrane roofing system.

B. **Related Sections**:
1. **Division 06** Section "**Rough Carpentry**" for wood nailers, curbs, and blocking.
2. **Division 06** Section "**Sheathing**" for wood-based, structural-use roof deck panels.
3. **Division 7** Section "**Preparation for Re-Roofing**" for removal of existing roofing on original Stromberg building.
4. **Division 07** Section "**Thermal Insulation**" for insulation beneath the roof deck.
5. **Division 7** Section "**Ethylene Interpolymer (KEE) Roofing**" for alternative roofing system - Contractor may use either KEE or PVC roofing, provided warranties, serviceability, and other features are equivalent.
6. **Division 7** Section "**Sheet Metal Flashing and Trim**" for metal roof penetration flashings, flashings, and counterflashings.
7. **Division 7** Section "**Joint Sealants**" for joint sealants, joint fillers, and joint preparation.
8. **Division 22** Section "**Storm Drainage Piping Specialties**" for roof drains.

### 1.3 DEFINITIONS

A. **Roofing Terminology**: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

### 1.4 PERFORMANCE REQUIREMENTS

A. **General Performance**: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. **Material Compatibility**: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. **Roofing System Design**: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. **FM Approvals Listing**: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system. Identify materials with FM Approval markings.
   1. **Fire/Windstorm Classification**: Class **1A-90**.
   2. Hail Resistance: **MH.**

E. **Energy Performance**: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

## 1.5 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Shop Drawings**: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
   5. Provide project-specific details for all conditions required to complete the project, coordinated with adjacent construction.

C. **Samples for Verification**: For the following products:
   1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
   2. Roof insulation.
   3. Walkway pads.
   4. Metal termination bars.
   5. Battens.
   6. Six insulation fasteners of each type, length, and finish.
   7. Six roof cover fasteners of each type, length, and finish.

D. **Qualification Data:** For qualified Installer and manufacturer.

E. **Manufacturer Certificates**: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.

F. **Product Test Reports**: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. **Research/Evaluation Reports**: For components of membrane roofing system, from the ICC-ES.

H. **Maintenance Data**: For roofing system to include in maintenance manuals.

I. **Warranties**: Sample of special warranties.

## 1.6 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
   1. Manufacturer must be **listed in NRCA's low slope roofing materials guide.**
   2. Manufacturer must have a **10-year successful history** as a roofing manufacturer.
   3. The **system** must have a **five year successful history.**
   4. Manufacturer must show **documented proof of how they plan to meet warranty obligations**. Must be provided in contractor's submittal package.
   5. Manufacturer must have a **certified installer/contractor program**. This program must include continuing education for the contractor.
   6. **Contractor must submit a pre-installation notice** signed by an authorized representative of the manufacturer prior to start of any work. This will include confirmation that the membrane and all accessories being used meet requirements of specification. This will also include confirmation that the scope of work is in accordance with published technical data as per manufacturer. This also includes confirmation that a warranty has been requested and will be issued on the DFCM manufacturer warranty form at the completion of roofing. This document must be included in contractor's submittal package.
   7. Manufacturer must have a **history of meeting Warranty** obligations.
   8. Manufacturer shall r**elease all inspection reports** concerning warranted roof system to the Contractor to submit to project Architect.

B. **Installer Qualifications**: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Furnish **24 hour emergency contact number** for Owner's use.
   1. Firm must have a minimum of **5 years experience** installing roofing system.
   2. Contractor must be **legally licensed** to perform roofing work in the State of Utah and **carry liability insurance** as required by State of Utah law.
   3. Firm must **document continuing education for the foreman** that will daily oversee the work on the roofing system. A minimum of **12 hours per year** is required.
   4. **On-site foreman must be able to clearly communicate** with building Owner/occupants.

C. **Source Limitations**: Obtain components including fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. **Exterior Fire-Test Exposure**: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. **Pre-installation Roofing Conference**: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver roofing materials** to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. **Store liquid materials** in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. **Handle and store roofing materials** and place equipment in a manner to avoid permanent deflection of deck.

## 1.8 PROJECT CONDITIONS

A. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.9 WARRANTY

A. Contractor to use **Owner's DFCM Forms** attached to this section.

B. **Special Warranty**: DFCM customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
1. **Special warranty includes** membrane roofing, base flashings, fasteners, substrate board, roofing accessories, and other components of membrane roofing system.
2. **Warranty Period**: 20 years from date of Substantial Completion

C. **Special Project Warranty**: Submit roofing Installer's DFCM warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, fasteners, substrate boards, and walkway products, for the following warranty period:
1. **Warranty Period**: **5 years** from date of Substantial Completion.

D. **Warranty Sign:** Provide a metal sign with vinyl lettering with the following information:

**CAUTION**

This roof is under warranty until (insert year) with (insert manufacturer). All access is to be restricted without facilities manager's permission & log entry. Repair work if necessary should be performed only by an authorized applicator. For leak repairs, contact (insert manufacturer) @ (insert manufacturer warranty claim department phone number) and provide them with warranty number. Questions regarding this roof or any potential work pertaining to this roof, please contact DFCM @ 801-538-3018.

| | |
|---|---|
| Warranty #: | Roofing Contractor: |
| Warranty Type: | Contractor Telephone #: |
| Installation Date: | Contractor Address: |
| Manufacturer's Address: | Roof Membrane Type: |

1. Install signs at all roof access points.
2. Signs shall be minimum 20 gage metal, with rounded corners, no larger than 10 x 14 inches, long dimension horizontal.

## PART 2 - PRODUCTS

### 2.1 PVC MEMBRANE ROOFING

A. **PVC Sheet**: ASTM D 4434, Type III, liquid coated, acrylic coated, fabric reinforced. Membrane must be manufactured by the company supplying the warranty **(no private labeling)** with a minimum 20 yr successful track record.

1. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include the following:
   a. **Sarnafil** Inc.
2. **Thickness:** 60 mils (1.5 mm), nominal, with minimum 20 mils above reinforcing.
3. **Exposed Face Color**: White.

### 2.2 ROOF INSULATION

A. **General:** Preformed roof insulation boards manufactured or approved by KEE membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

1. Total System R value of **R30 minimum** predicated upon Long Term Thermal Resistance Criteria (LTTR) of R6 per inch.
2. Insulation shall be included in roofing manufacturer's 20 year warranty.

B. **Polyisocyanurate Board Insulation:** ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. **Tapered Insulation:** Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. **Provide preformed saddles**, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

### 2.3 INSULATION ACCESSORIES

A. **General:** Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

## 2.4 AUXILIARY MEMBRANE ROOFING MATERIALS

A. **General**: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
   1. **Liquid-type auxiliary materials** shall comply with VOC limits of authorities having jurisdiction.

B. **Sheet Flashing**: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.

C. **Bonding Adhesive**: Manufacturer's standard.

D. **Metal Termination Bars**: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. **Fasteners**: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. **Coated Flashings**: Manufacturer's standard PVC coated metal flashings in thickness as recommended by manufacturer for indicated use and complying with performance requirements, but with metal thickness not less than 0.028 inches.

G. **Miscellaneous Accessories**: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

## 2.5 SUBSTRATE BOARDS

A. **Substrate Board:** ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Georgia-Pacific Corporation; **Dens Deck**.
      b. Temple-Inland; **GreenGlass**.
   2. Any product used shall be approved by the roofing system manufacturer and authorized as part of their comprehensive warranty.

B. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

## 2.6 WALKWAYS

A. **Flexible Walkways**: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. **Proceed with installation** only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. **Clean substrate** of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. **Prevent materials from entering and clogging roof drain**s and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. **Prevent materials from spilling** or migrating onto surfaces of other construction.

D. **Complete terminations** and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 SUBSTRATE BOARD

A. **Install substrate board** with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
   2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

### 3.4 INSULATION INSTALLATION

A. **Coordinate** installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. **Comply** with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. **Install tapered insulation** under area of roofing to conform to slopes indicated.

D. **Install one or more layers** of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. **Trim surface of insulation** where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. **Install** insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   1. **Cut and fit** insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. **Mechanically Fastened Insulation**: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. **Fasten insulation** according to requirements in FMG's "RoofNav" for specified Windstorm Resistance Classification.
   2. **Fasten insulation to resist uplift pressure** at corners, perimeter, and field of roof.

## 3.5 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. **Mechanically fasten** membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.
   1. Install sheet according to ASTM D 5082.

B. **Start installation** of membrane roofing in presence of roofing system manufacturer's technical personnel.

C. **Accurately align membrane roofing** and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. **Mechanically fasten** or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. **Apply membrane roofing** with side laps shingled with slope of roof deck where possible.

F. **Seams**: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. **Test lap edges** with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
   2. **Verify field strength of seams** a minimum of twice daily and repair seam sample areas.
   3. **Repair tears**, voids, and lapped seams in roofing that does not comply with requirements.

## 3.6 BASE FLASHING INSTALLATION

A. **Install sheet flashings** and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. **Apply bonding adhesive** to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. **Flash penetrations** and field-formed inside and outside corners with cured or uncured sheet flashing.

D. **Clean seam areas**, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. **Terminate and seal** top of sheet flashings.

## 3.7 WALKWAY INSTALLATION

A. **Flexible Walkways**: Install walkway products from **roof access locations** to all **mechanical units**, **penthouses** and **any other roof locations** where access to roof items is required. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

## 3.8 FIELD QUALITY CONTROL

A. **Testing Agency**: Owner will engage a qualified testing agency to perform tests and inspections.

B. **Final Roof Inspection:** Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
   1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
   2. Schedule final inspection to allow attendance of DFCM roofing program manager, Owner's representative, and Architect.

C. **Repair or remove and replace** components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. **Additional inspections**, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.9 PROTECTING AND CLEANING

A. **Protect membrane roofing** system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. **Correct deficiencies** in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. **Clean overspray and spillage** from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

## 3.10 WARRANTY FORMS - DFCM

**END OF SECTION**

## SECTION 07 6200

## SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following sheet metal flashing and trim:
1. Manufactured **reglets**.
2. Formed **roof drainage** system.
3. Formed **low-slope roof flashing** and trim.
4. Formed **wall flashing** and trim.
5. **Pre-installation** conference.

B. **Related Sections** include the following:
1. **Division 4** Section "**Unit Masonry Assemblies**" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
2. **Division 6** Section "**Rough Carpentry**" for wood nailers, curbs, and blocking.
3. **Division 7** Section "**Roofing**" for installing sheet metal flashing and trim integral with roofing membrane.
4. **Division 7** Section "**Roof Accessories**" for set-on-type curbs, roof hatches, and other manufactured roof accessory units.
5. **Division 7** Section "**Joint Sealants**" for field-applied sheet metal flashing and trim sealants.

### 1.3 PERFORMANCE REQUIREMENTS

A. **General**: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. **Wind Loading**: Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
1. **Wind Zone 1**: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-kPa) outward force.

C. **Thermal Movements**: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. 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** (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. **Water Infiltration**: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

## 1.4 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**: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.
5. Provide project-specific details for all conditions required to complete the project, coordinated with adjacent construction.

C. **Samples for Selection**: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.

## 1.5 QUALITY ASSURANCE

A. **Sheet Metal Flashing and Trim Standard**: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. **Mockups**: Prior to installing sheet metal flashing and trim, construct mockups indicated to verify selections made under Sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
1. **Locate mockups** on-site in the location and of the size indicated or, if not indicated, as directed by Architect.
2. **Notify Architect** one week in advance of the dates and times when mockups will be constructed.
3. **Demonstrate the proposed range of aesthetic effects** and workmanship.
4. **Construct mockups** for the following type of sheet metal flashing and trim:
   a. **Exposed trim**, gravel stops, and fasciae.
   b. **Copings**.
5. **Obtain Architect's approval of mockups** before start of final unit of Work.
6. **Retain and maintain mockups** during construction in an undisturbed condition as a standard for judging the completed Work.
   a. **When directed**, demolish and remove mockups from Project site.
   b. **Approved mockups** in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

C. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
   1. **Meet with Owner, Architect, Owner's insurer** if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
   2. **Review methods and procedures** related to sheet metal flashing and trim.
   3. **Examine substrate conditions** for compliance with requirements, including flatness and attachment to structural members.
   4. **Document proceedings**, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. **Unload, store, and install** sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. **Stack materials** on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

## 1.7 COORDINATION

A. **Coordinate installation** of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

# 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. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
   2. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

## 2.2 SHEET METALS

A. **Zinc-Coated (Galvanized) Steel Sheet**: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality, mill phosphatized for field painting.

B. **Pre-painted, Metallic-Coated Steel Sheet**: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. **Zinc-Coated** (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2. **Exposed Finishes**: Apply the following coil coating:
   a. **High-Performance Organic Finish**: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      1) **Fluoropolymer Two-Coat System**: Manufacturer's standard two-**coat**, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat with color coat containing not less than **70 percent** polyvinylidene fluoride **resin by weight,** complying with physical properties and coating performance requirements of AAMA 621, except as modified below
         (a) **Humidity Resistance**: 2000 hours.
         (b) **Salt-Spray Resistance**: 2000 hours.
      2) **Color**: As selected by Architect from manufacturer's full range including deep tone colors.
3. **Lead Sheet:** ASTM B 749, Type L51121, copper-bearing lead sheet.
4. **Zinc Sheet**: Electrolytic, 99 percent pure zinc alloyed with 1 percent titanium and copper.
   a. **Finish**: Bright rolled.

## 2.3 UNDERLAYMENT MATERIALS

A. **Polyethylene Sheet**: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. **Slip Sheet**: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

## 2.4 MISCELLANEOUS MATERIALS

A. **General**: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. **Fasteners**: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
   1. **Exposed Fasteners**: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
   2. **Fasteners for Flashing and Trim**: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
   3. **Blind Fasteners**: High-strength aluminum or stainless-steel rivets.
   4. **Spikes and Ferrules**: Same material as gutter; with spike with ferrule matching internal gutter width.

C. **Solder for Zinc**: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

D. **Sealing Tape**: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. **Elastomeric Sealant**: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. **Butyl Sealant**: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

G. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. **Reglets**: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counter flashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.
   1. **Available Manufacturers**:
      a. **Fry** Reglet Corporation.
   2. **Material**: Galvanized steel, **24 gauge**.
   3. **Surface-Mounted Type**: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. **Masonry Type**: Provide with offset top flange for embedment in masonry mortar joint.
      a. **Available Manufacturers**:
         1) **Cheney** Flashing Company, Inc., Type B Snap Lock.
   5. **Flexible Flashing Retainer**: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counter flashing or where Drawings show reglet without metal counter flashing.
   6. **Counter flashing Wind-Restraint Clips**: Provide clips to be installed before counter flashing to prevent wind uplift of counter flashing lower edge.

## 2.6 FABRICATION, GENERAL

A. **General**: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. **Fabricate** sheet metal flashing and trim in **thickness or weight needed to comply with performance requirement**s, but not less than that specified for each application and metal.

C. **Fabricate** sheet metal flashing and trim **without excessive oil canning,** buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   1. **Seams for Other Than Aluminum**: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. **Sealed Joints**: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. **Seams**: Comply with SMACNA “Architectural Sheet Metal Manual”, (**Sixth Edition**, September 2003) Figure no. 3-2 and 3-3 as applicable to specific installations.
   1. **Standing Seams:** Provide double lock standing seams (detail no. 25, figure no. 3-3), with finish not less than 1-1/4" high.

F. **Expansion Provisions**: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

G. **Conceal fasteners** and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

H. **Fabricate cleats** and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
   1. **Thickness**: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. **Copings**: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
   1. **Joint Style**: Standing seams.
   2. **Fabricate copings** from the following material:
      a. **Prepainted, Metallic-Coated Steel**: **22 gauge**.

B. **Roof and Roof to Wall Transition Expansion-Joint Cover**: Fabricate from the following material:
   1. Prepainted, Metallic-Coated Steel: **22 gauge**.

C. **Base Flashing**: Fabricate from the following material:
   1. Galvanized Steel: **22 gauge**.

D. **Counter flashing**: Fabricate from the following material:
   1. Galvanized Steel: **24 gauge**.

E. **Flashing Receivers**: Fabricate from the following material:
   1. Galvanized Steel: **24 gauge**.

F. **Roof-Penetration Flashing**: Fabricate from the following material:
   1. Galvanized Steel: **22 gauge**.

G. **Roof-Drain Flashing**: Fabricate from the following material:
   1. Lead: 4.0 lb/sq. ft. (1.6 mm thick), hard tempered.

## 2.8 WALL SHEET METAL FABRICATIONS

A. **Through-Wall Flashing**: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12 foot (3.6 m) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high end dams. Fabricate from the following material:
   1. Zinc: **15 gauge** (0.040 inch) thick.

B. **Openings Flashing in Frame Construction**: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high end dams. Fabricate from the following material:
1. Prepainted, Metallic-Coated Steel: **24 gauge**.

C. **Wall Expansion-Joint Cover**: Fabricate from the following material:
1. Prepainted, Metallic-Coated Steel: **22 gauge**.

## 2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. **Equipment Support Flashing**: Fabricate from the following material:
1. Galvanized Steel: **22 gauge**.

## 2.10 FINISHES

A. **Comply** with NAAMM's "**Metal Finishes Manual for Architectural and Metal Products**" for recommendations for applying and designating finishes.

B. **Protect mechanical and painted finishes** on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. **Appearance of Finished Work**: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION, GENERAL

A. **General**: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Torch cutting of sheet metal flashing and trim is not permitted.

B. **Metal Protection**: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
1. **Coat** side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. **Underlayment**: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
3. **Bed flanges** in thick coat of asphalt roofing cement where required for waterproof performance.

C. **Install exposed sheet metal flashing** and trim without excessive oil canning, buckling, and tool marks.

D. **Install sheet metal flashing** and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. **Install flashing** and trim so that **any edge that can be seen** will not reveal the **back side** of the flashing.

F. **Install sheet metal flashing and trim** to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
1. **Space cleats** not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

G. **Expansion Provisions**: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

H. **Fasteners**: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.

I. **Seal joints** with elastomeric sealant as required for watertight construction.
1. **Where sealant-filled joints are used**, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. **Prepare joints** and apply sealants to comply with requirements in **Division 7** Section "**Joint Sealants**."

J. **Soldered Joints**: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.
1. **Do not solder prepainted**, metallic-coated steel sheet.
2. **Pretinning** is not required for lead.
3. **Where surfaces to be soldered** are lead coated, do not tin edges, but wire brush lead coating before soldering.
4. **Do not use open-flame torches for soldering**. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

## 3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. **General**: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. **Expansion-Joint Covers**: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

C. **Splash Pans**: Install where downspouts discharge on low-sloped roofs. Set in elastomeric sealant compatible with roofing membrane.

## 3.4 ROOF FLASHING INSTALLATION

A. **General**: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. **Roof Edge Flashing**: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch (400-mm) centers.

C. **Copings**: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16-inch (400-mm) centers.
   2. Anchor interior leg of coping with screw fasteners and washers at 18-inch (450-mm) centers.

D. **Pipe or Post Counter flashing**: Install counter flashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. **Counter flashing**: Coordinate installation of counter flashing with installation of base flashing. Insert counter flashing in reglets or receivers and fit tightly to base flashing. Extend counter flashing 4 inches (100 mm) over base flashing. Lap counter flashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.
   1. Secure in a waterproof manner by means of snap-in installation and sealant.

F. **Roof-Penetration Flashing**: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
   1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

## 3.5 WALL FLASHING INSTALLATION

A. **General**: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. **Openings Flashing in Frame Construction**: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

## 3.6 MISCELLANEOUS FLASHING INSTALLATION

A. **Equipment Support Flashing**: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

## 3.7 CLEANING AND PROTECTION

A. **Clean exposed metal surfaces** of substances that interfere with uniform oxidation and weathering.

B. **Clean and neutralize flux materials**. Clean off excess solder and sealants.

C. **Remove temporary protective coverings** and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. **Replace sheet metal flashing** and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

# SECTION 07 7200

# ROOF ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Roof hatches

B. **Related Sections** include the following:
   1. **Division 5** Section "**Metal Fabrications**" for metal vertical ladders for access to roof hatches.
   2. **Division 7** low-slope **roofing Sections** for roofing accessories.
   3. **Division 7** Section "**Sheet Metal Flashing and Trim**" for shop- and field-fabricated metal flashing and counter flashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. **Shop Drawings**: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. **Coordination Drawings**: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. **Warranty**: Special warranty specified in this Section.

### 1.4 QUALITY ASSURANCE

A. **Sheet Metal Standard**: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

## 1.6 PROJECT CONDITIONS

A. **Field Measurements**: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak proof, weather tight, secure, and non-corrosive installation.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

## 2.2 METAL MATERIALS

A. **Galvanized Steel Sheet**: ASTM A 653/A 653M, G90 (Z275) coated and mill phosphatized for field painting.

B. **Steel Shapes**: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.

C. **Galvanized Steel Tube**: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.

D. **Galvanized Steel Pipe**: ASTM A 53/A 53M.

## 2.3 MISCELLANEOUS MATERIALS

A. **Glass-Fiber Board Insulation**: ASTM C 726, 1 inch (25 mm) thick.

B. **Wood Nailers**: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

C. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

D. **Fasteners**: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

E. **Gaskets**: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

F. **Elastomeric Sealant**: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 2.4 ROOF HATCHES

A. **Roof Hatches:** Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counter flashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weather tight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   a. **Manufacturer:** The Bilco Company.
   b. **Product:** Type S roof hatch.
2. **Available Manufacturers:** Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. **Babcock-Davis**; a Cierra Products Inc. Company.
   b. The **Bilco** Company.
   c. **Dur-Red** Products.
   d. **Milcor** Inc.; a Gibraltar Company.

B. **Properties:**

1. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. (1.9-kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loads.
2. **Type and Size:** Single-leaf lid, 36 by 30 inches (914 by 762 mm).
3. **Curb and Lid Material:** Type 304 stainless steel sheet, 14 gauge (2 mm) thick.
   a. Finish: Bead blast.
4. **Insulation:** Glass-fiber board.
5. **Interior Lid Liner:** Manufacturer's standard metal liner of same material and finish as outer metal lid.
6. **Exterior Curb Liner**: Manufacturer's standard metal liner of same material and finish as metal curb.
7. **Fabricate units to minimum height of 12 inches** (300 mm), unless otherwise indicated.
8. **Sloping Roofs:** Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units.
9. **Hardware**: Galvanized steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

## 2.5 LADDER SAFETY POST

A. **Ladder Safety Post**: Furnish and install ladder safety post at each roof hatch.

1. **Pre-assemble** ladder safety post at factory.
2. **Performance characteristics:**
   a. Tubular post shall lock automatically when fully extended.
   b. Safety post shall have controlled upward and downward movement.
   c. Release lever shall disengage the post to allow it to be returned to its lowered position.

d. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14” on center and clamp brackets to accommodate ladder rungs up to 1-3/4” in diameter.

3. **Post:** Manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
4. **Material**: Steel.
5. **Balancing Spring**: Stainless steel spring balancing mechanism to provide smooth, easy, controlled operation when raising and lowering the safety post.
6. **Hardware:** Type 316 stainless steel.
7. **Finishes:** Hot dip galvanized

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
1. **Verify that substrate is sound,** dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. **Verify dimensions** of roof openings for roof accessories.
3. **Proceed with installation** only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. **General**: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. **Install roof accessories** to fit substrates and to result in watertight performance.

C. **Metal Protection**: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. **Install roof accessories level, plumb, true** to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. **Roof Hatch Installation**:
1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
2. Attach safety railing system to roof hatch curb.

F. **Seal joints** with elastomeric sealant as required by manufacturer of roof accessories.

## 3.3 TOUCH UP

A. **Touch up factory-primed surfaces** with compatible primer ready for field painting in accordance with Division 9 painting Sections.

B. **Galvanized Surfaces**: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

## 3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

**END OF SECTION**

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## SECTION 07 8113

## SPRAYED FIRE-RESISTIVE MATERIALS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. **Concealed** sprayed fire-resistive materials.
2. **Exposed** sprayed fire-resistive materials.
3. **Preparation and priming of new and existing steel** to accommodate fireproofing materials.

B. **Related Sections** include the following:
1. **Division 1** Section "**Alternates**" for language related to use of sprayed fire-resistive materials in lieu of intumescent paint.
2. **Division 5** Section "**Structural Steel**" for surface conditions required for new structural steel receiving sprayed fire-resistive materials. Primers must be compatible with fireproofing.
3. **Division 7** Section "**Through-Penetration Firestop Systems**" for fire resistance-rated firestopping systems.
4. **Division 7** Section "**Fire-Resistive Joint Systems**".
5. **Division 7** Section "**Intumescent Paints**" for thin-coat fireproofing products.
6. **Division 9** Section "**Gypsum Board**" for gypsum-board-based fire protection.

### 1.3 DEFINITIONS

A. **Concealed Sprayed Fire-Resistive Materials:** Applied to surfaces that are concealed from view behind other construction when the Work is completed.

B. **Exposed Sprayed Fire-Resistive Materials**: Applied to surfaces that are exposed to view when the Work is completed.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Shop Drawings:** Structural framing plans indicating the following:
1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
   a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

c. Designation of restrained and unrestrained conditions based on definitions in ASTM E 119, Appendix X3 as determined by a qualified professional engineer.
d. Treatment of sprayed fire-resistive material after application.

C. **Product Certificates:** For each type of sprayed fire-resistive material, signed by product manufacturer.

D. **Qualification Data:** For Installer, and manufacturer.

E. **Compatibility and Adhesion Test Reports**: From sprayed fire-resistive material manufacturer indicating the following:
1. Materials have been tested for bond with substrates.
2. Materials have been verified by sprayed fire-resistive material manufacturer to be compatible with substrate primers and coatings.
3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. **Product Test Reports:** Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed sprayed fire-resistive materials.

G. **Warranties:** Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications:** A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. **Source Limitations:** Obtain sprayed fire-resistive materials through one source from a single manufacturer.

C. **Sprayed Fire-Resistive Materials Testing**: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

D. **Compatibility and Adhesion Testing:** Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
   1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
   2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with sprayed fire-resistive material.

E. **Fire-Test-Response Characteristics:** Provide sprayed fire-resistive materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing sprayed fire-resistive materials with appropriate markings of applicable testing and inspecting agency.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection tested per ASTM E 119.
   2. Surface-Burning Characteristics: ASTM E 84.

F. **Asbestos Free**: Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

G. **Mockups**: Apply mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
   1. Locations of Mockups: As indicated on Drawings and as directed by architect.
   2. Extent of Mockups: Approximately 100 sq. ft. (9 sq. m) of surface for each product indicated.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. **Pre-installation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to sprayed fire-resistive materials including, but not limited to, the following:
   1. Review and finalize construction schedule and verify sequencing and coordination requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver products** to Project site **in original, unopened package**s with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. **Use materials with limited shelf life within period indicated**. Remove from Project site and discard materials whose shelf life has expired.

C. **Store materials inside**, under cover, aboveground, and kept dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

## 1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not apply sprayed fire-resistive material when ambient or substrate temperature is 40 deg F (4 deg C) or lower unless temporary protection and heat is provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application. General Contractor shall provide enclosures with heat to maintain temperatures.

B. **Ventilation**: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly. Ventilation shall not be less than 4 complete air exchanges per hour until the SFRM is fully cured. General Contractor shall provide ventilation to allow proper drying of the SFRM during and subsequent to its application.

## 1.8 COORDINATION

A. **Sequence and coordinate application** of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:
   1. **Verify compatibility of steel primers and coatings** prior to shop or field finishing of steel components.
   2. **Provide temporary enclosure** as required to confine spraying operations and protect the environment.
   3. **Provide temporary enclosures** for applications **to prevent deterioratio**n of fire-resistive material **due to exposure to weather** and to unfavorable ambient conditions for humidity, temperature, and ventilation.
   4. **Avoid unnecessary exposure** of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
   5. **Do not apply fire-resistive material to metal roof deck** substrates u**ntil concrete topping, if any, has been completed.** For metal r**oof decks without concrete topping**, **do not apply** fire-resistive material to metal roof deck substrates **until roofing has been completed**; prohibit roof traffic during application and drying of fire-resistive material.
   6. **Do not apply** fire-resistive material **to metal floor deck** substrates **until concrete topping has been completed.**
   7. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
   8. **Defer installing ducts, piping, and other items** that would interfere with applying fire-resistive material until application of fire protection is completed.
   9. **Do not install enclosing or concealing construction** until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

## 1.9 WARRANTY

A. **Special Warranty:** Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace sprayed fire-resistive materials that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of sprayed fire-resistive materials from substrates.

2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
3. **Warranty Period: Two years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. **General:** For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and physical properties representative of installed products.

B. **Available Products:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
1. **Cementitious Sprayed Fire-Resistive Material:**
   a. W. R. **Grace** & Co. Construction Products Div.; **Monokote Type MK-6/HY.**
   b. **Isolatek Cafco 300.**
2. **Material Composition:**
   a. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
3. **Physical Properties:** Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
   a. **Dry Density:** 15 lb/cu. ft. (240 kg/cu. m) for average and individual densities regardless of density indicated in referenced fire-resistance design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
   b. **Thickness:** Provide minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch (9 mm), per ASTM E 605:
      1) Where the referenced fire-resistance design lists a thickness of 1 inch (25 mm) or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch (6 mm).
      2) Where the referenced fire-resistance design lists a thickness of less than 1 inch (25 mm) but more than 0.375 inch (9 mm), the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch (9 mm) or 75 percent of the design thickness.
      3) No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft. (240 kg/cu. m).
   c. **Bond Strength:** 150 lb/sq. ft. (7.2 kPa) minimum per ASTM E 736 under the following conditions:
      1) Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.

2) If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lb/sq. ft. (7.2 kPa) minimum per ASTM E 736.

3) Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch (19 mm).

d. **Compressive Strength:** 750 lb /sq.ft. (35.9 kPa) as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch (19 mm) and minimum dry density shall be as specified, but not less than 15 lb/cu. ft. (240 kg/cu. m).

e. **Corrosion Resistance:** No evidence of corrosion per ASTM E 937.

f. **Deflection:** No cracking, spalling, or delamination per ASTM E 759.

g. **Effect of Impact on Bonding:** No cracking, spalling, or delamination per ASTM E 760.

h. **Air Erosion:** Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch (19 mm), maximum dry density is 15 lb/cu. ft. (240 kg/cu. m), test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

i. **Fire-Test-Response Characteristics:** Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1) Flame-Spread Index: 0 or less.

2) Smoke-Developed Index: 0.

j. **Fungal Resistance:** No observed growth on specimens per ASTM G 21.

## 2.2 EXPOSED CEMENTITIOUS SPRAYED FIRE-RESISTIVE MATERIALS

A. **General:** For exposed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

B. **Available Products:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

1. **Exposed Cementitious Sprayed Fire-Resistive Material:**

a. W. R. **Grace** & Co., Construction Products Div.; **Monokote Type Z106 or Z106HY** portland cement binder.

b. **Isolatek Cafco 400** portland cement binder.

2. **Exposed Cementitious Sprayed Fire-Resistive Material:** Factory-mixed, dry, cement aggregate formulation; or chloride-free formulation of portland cement binders, additives, and inorganic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application, complying with the following requirements:

a. **Dry Density:** Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 22 lb/cu. ft. (625 kg/cu. m).

b. **Bond Strength:** 434 lb/sq. ft. (48 kPa) minimum per ASTM E 736.

c. **Compressive Strength:** 7344 lb./sq. ft. (351 kPa) per ASTM E 761.

d. **Corrosion Resistance**: No evidence of corrosion per ASTM E 937.
e. **Deflection**: No cracking, spalling, or delamination per ASTM E 759.
f. **Effect of Impact on Bonding**: No cracking, spalling, or delamination per ASTM E 760.
g. **Air Erosion:** Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) per ASTM E 859.
h. **Combustion Characteristics**: Passes ASTM E 136.
i. **Fire-Test-Response Characteristics**: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1) Flame-Spread Index: 0 or less.
   2) Smoke-Developed Index: 0.
j. **Fungal Resistance**: No observed growth on specimens per ASTM G 21.
k. **Capable of being finished with dry-fall type paint** or other finish system without impairing fire-resistive properties.

## 2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

A. **General:** Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. **Substrate Primers:** For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory," for coating materials based on a series of bond tests per ASTM E 736.
2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
3. For bonding to galvanized roof deck, cementitious Portland cement based spray accessory product comparable to Grace "Spatterkote SK-3".
4. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.
5. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.
6. Topcoat: Type recommended in writing by manufacturer of each sprayed fire-resistive material for application over exposed sprayed fire-resistive materials.
   a. Topcoat shall be used in a finish paint coat is to be applied, as recommended by fire-resistive material manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates, areas, and conditions**, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:

1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
   a. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.
   b. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. **Cover other work subject to damage** from fallout or overspray of fire-resistive materials during application.

B. All surfaces to receive fire protection **shall be free of** oil, grease, loose mill scale, dirt paints/primers (other than those listed and tested) or other **foreign materials**, which would impair satisfactory bonding to the surface. Manufacturer shall be contacted for procedures on handling primed/painted steel. Any cleaning of the surfaces to receive sprayed fire protection shall be the responsibility of the General Contractor or Steel Erector.

1. **Existing steel to receive spray-applied fireproofing shall be blasted to bare metal according to SSPC-SP 10/NACE No. 2..** Verify exact requirements with fireproofing manufacturer. Protect adjoining work from effects of blasting/cleaning.

### 3.3 INSTALLATION, GENERAL

A. **Comply with fire-resistive material manufacturer's written instructions** for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. **Apply sprayed fire-resistive material that is identical to products tested** as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. **Install metal lath**, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

D. **Coat substrates with adhesive** before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by sprayed fire-resistive material manufacturer for material and application indicated.

E. **Apply cementitious spray accessory product** in accordance with manufacturer's instructions. 100 percent coverage of galvanized surfaces is not acceptable.

F. **Extend fire-resistive material in full thickness** over entire area of each substrate to be protected. Unless otherwise recommended in writing by sprayed fire-resistive material manufacturer, install body of fire-resistive covering in a single course.

G. **Spray-apply fire resistive materials to maximum extent possible**. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

## 3.4 INSTALLATION, CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. **Apply concealed sprayed fire-resistive material in thicknesses and densities not less than those required** to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed Sprayed Fire-Resistive Materials" Article.

## 3.5 INSTALLATION, EXPOSED SPRAYED FIRE-RESISTIVE MATERIALS

A. **Apply exposed sprayed fire-resistive material in thicknesses and densities not less than those required** to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if indicated.
   1. For **steel beams and bracing**, provide a **thickness of not less than 1 inch** (25 mm).
   2. For **metal floor or roof decks**, provide a **thickness of not less than 1/2 inc**h (13 mm).
      a. Provide a uniform finish complying with description indicated for each type of material and matching Architect's sample or, if none, finish approved for field-erected mockup.
      b. Apply exposed cementitious sprayed fire-resistive material to produce the following finish:
         1) Uniform spray-textured finish with no further treatment. Care should be taken to avoid “drop-outs” during final thickness pass. No hand patching will be allowed in exposed areas.

**END OF SECTION**

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# SECTION 07 8126

# INTUMESCENT PAINTS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This **Section includes surface preparation and application of intumescent paints** to scheduled items and surfaces, including prime and finish coats.

### 1.2 RELATED DOCUMENTS

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

B. **Division 1** Section "**Alternates**" for language related to use of sprayed fire-resistive materials in lieu of intumescent paint.

C. **Division 5** "**Metals**" sections for coordination of primers on structural elements with intumescent paints. Primers must be compatible with intumescent paints and fireproofing.

D. **Division 7** Section "**Sprayed Fire Resistive Materials**" for cementitious fireproofing.

### 1.3 SUBMITTALS

A. **Product Data:** For each intumescent paint system indicated. Include block fillers and primers.

B. **Material List:** Provide an inclusive list of required intumescent paint materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

C. **Manufacturer's Information**: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying intumescent paint materials.

D. **Certification:** By the manufacturer that products supplied comply with local regulations controlling use of VOCs.

E. **Samples for Selection:** Manufacturer's color charts showing the full range of colors available for each intumescent paint finish indicated.
   1. After color selection, the Architect will furnish color chips for surfaces to be coated.

F. **Samples for Verification**: For each color 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 fillers, primers, and finish coats. 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 finish sample. Label each sample for location and application.
3. Submit Samples on the following substrates for the Architect's review of color and texture only:
   a. Ferrous Metal: Two 8-inch- (200-mm-) square samples of flat metal, and two 8-inch- (200-mm-) long samples of solid metal for each color and finish.

G. **Qualification Data:** For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

H. **Product Test Reports**: From a qualified testing agency indicating that intumescent paint materials comply with requirements indicated, based on comprehensive testing of current product formulations.

## 1.4 QUALITY ASSURANCE

A. **Applicator Qualifications**: An experienced applicator who has completed intumescent painting applications similar in material and extent to that indicated for the Project and whose work has resulted in application with a record of successful in-service performance.

B. **Source Limitations**: Obtain block fillers, primers, and undercoat materials for each intumescent paint system from the same manufacturer as the finish coats.
1. Notify the Architect of problems anticipated using specified coating systems.

C. **Fire-Test-Response Characteristics:** Provide intumescent paint materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Flame Spread: 25.
2. Smoke Developed: 25.

D. **Standard:** Intumescent paint is to meet the requirements of “Technical Manual 12-B” second edition of the Association of the Wall and Ceiling Industry (AWCI), 513 West Broad Street, Suite 210, Falls Church, VA 22045 (703) 538-1600. .

E. **Benchmark Samples (Mockups):** Provide a full-coat benchmark finish sample for each type of coating and substrate required. Duplicate finish of approved sample Submittals.
1. The Architect will select one surface for each substrate to receive intumescent paint to represent surfaces and conditions for application of each type of coating.
   a. Wall Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Small Areas and Items: The Architect will designate an item or area required.
2. Notify the Architect seven days in advance of dates and times when benchmark samples will be applied.
3. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated.
4. Obtain the Architect's approval of benchmark samples before starting intumescent paint application.
5. Maintain benchmark samples during construction in an undisturbed condition as a standard for judging the completed Work.
6. Final approval of colors will be from benchmark samples.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. **Deliver intumescent paint materials** to the 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. UL label, indicating tested fire rating.
   4. Manufacturer's stock number and date of manufacture.
   5. Contents by volume, for pigment and vehicle constituents.
   6. Thinning and mixing instructions.
   7. Application instructions.
   8. Color name and number.
   9. VOC content.
   10. Handling instructions and precautions.

B. **Store materials** not in use i**n tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F** (7.2 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. **Protect intumescent paint materials from freezing**. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

## 1.6 PROJECT CONDITIONS

A. **Temperature Conditions:** Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are above 50 deg F (10 deg C).

B. **Weather Conditions:** Do not apply intumescent paints in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing with painting operations.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

## 1.7 EXTRA MATERIALS

A. Furnish extra intumescent paint materials from the same production run as materials applied in quantities described below. Package intumescent paint materials in unopened, factory-sealed containers for storage, and identify with labels describing contents. Deliver extra materials to the Owner.
   1. **Quantity:** Furnish the Owner with extra intumescent paint materials in the quantities indicated below:
      a. Latex Intumescent Paint: **2 gal**. (7.57 L) of each product applied.

## 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 the Intumescent Paint Schedule.

B. **Manufacturers' Names:** The following manufacturers are referred to in the Intumescent Paint Schedule by using shortened versions of their names, which are shown in parenthesis:
   1. **Basis of Design Products: Carboline**, an RPM Company (A/D); www.carboline.com
   2. **Albi** Manufacturing Co., Inc., (Albi); www.albi.com
   3. **Isolatek** (Iso/Cafco); www.isolatek.com

C. **UL design numbers indicated on Drawings are based on Carboline products**. Other manufacturers are acceptable, provided products fit project requirements and a UL design number for each condition exists for the product application.

### 2.2 INTUMESCENT PAINT MATERIALS, GENERAL

A. **Material Compatibility:** Provide fillers, primers, undercoats, and finish-coat materials 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.

B. **Material Quality:** Provide manufacturer's best-quality intumescent paint materials. Intumescent paint materials not displaying manufacturer's product identification will not be acceptable.
   1. Provide water-reducible or solvent-reducible, pigmented intumescent paint materials; formulated to retard flame spread and intended for use on interior combustible and noncombustible surfaces.
   2. Proprietary Names: Use of manufacturer's proprietary product names to designate colors 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 certificate of performance for proposed substitutions.

C. **Colors:** Multiple colors as selected by the Architect from manufacturer's full range.

D. **Solvent:** As recommended by the intumescent manufacturer for clean-up and for saturating roller for final finish.

E. **Fiberglass Ribbon**: 20 x 20 mesh with 0.004 inch thickness; weight 1.6 oz/sq. yard.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates, areas, and conditions,** with the Applicator present, under which painting will be performed for compliance with paint application requirements and conditions affecting coating performance.
   1. Proceed with intumescent paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as the Applicator's approval of surfaces and conditions within a particular area.

B. **Coordination of Work:** Review other Sections of these Specifications in which primers are provided to ensure compatibility of the total intumescent paint system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify the Architect about anticipated problems using coatings specified over substrates primed by others.

### 3.2 PREPARATION

A. **General:** Remove hardware, 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 the 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. **Cleaning:** Before applying coatings or other surface treatments, **clean substrates of substances that could impair bond** of the intumescent paint systems.
   1. Schedule cleaning and painting application so dust and other contaminates will not fall on wet, newly painted surfaces.

C. **Surface Preparation:** Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Surfaces to be coated must be free of oil, grease, dirt, rust, and paint.
   2. Remove oil and grease before mechanical cleaning.
   3. Remove existing coatings completely. Repair cracks and gouges.
   4. **Ferrous Metals:** Clean ungalvanized ferrous-metal surfaces that have not been shop primed. Remove oil, grease, dirt, loose mill scale, and other foreign substances, existing paint or other finishes. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
      a. **Blast steel surface**s as recommended by intumescent paint manufacturer and according to SSPC-SP 10/NACE No. 2.
   5. **Galvanized Metal Surfaces:** Clean galvanized metal surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants according to manufacturer's written instructions. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. **Material Preparation:** Mix and prepare intumescent paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying intumescent paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density, and as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Thinning: Use only thinners recommended by manufacturer and only within recommended limits.

## 3.3 APPLICATION

A. **General:** Apply intumescent paints to exposed surfaces indicated according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. **Colors**: Paint colors, surface treatments, and finishes are indicated in the schedules in the Contract Documents. Where an item or surface is not specifically mentioned in the schedules, coat the same color as similar adjacent materials or surfaces. If a color is not designated, the Architect will select a color from those available.
2. **Do not apply coatings over** dirt, rust, scale, grease, moisture, scuffed surfaces, or **conditions indicated as unacceptable** in manufacturer's written instructions, or to surfaces that are otherwise detrimental to forming an acceptable coating.

B. **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 the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. If undercoats or other conditions show through the 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.
3. Omit primer on metal surfaces that have been shop primed or touchup painted. **Verify compatibility of all primers.**
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where applying another coat of paint does not cause the undercoat to loose adhesion.

C. **Application Procedures:** Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers made of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. **Tinting:** Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient difference in the shade of the undercoats to distinguish each separate coat.

E. **Minimum Coating Thickness:** Apply materials at not less than manufacturer's recommended spreading rate for the surface to be coated. Provide the total dry film thickness of the entire system as recommended by the manufacturer to provide surface-burning characteristics specified.

F. **Filler Coat**: Apply filler over coarse and porous materials at a rate to ensure complete coverage with all pores filled.

G. **Prime Coat:** Before applying finish coats, apply a prime coat, as recommended by the manufacturer, to substrates required to be painted that have not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas appears in the first coat.

H. **Intumescent Paint:** Apply intumescent paint by brush, roller, or spray as recommended by the coating manufacturer for the type of substrate involved according to manufacturer's written instructions.
   1. Where multiple finish coats are required, allow the base or first coat to dry before applying topcoat according to manufacturer's written instructions.
   2. Where required by UL rating, embed fiberglass ribbon in intumescent paint, rolling with a smooth or short nap roller applying light pressure to the surface. Such procedure is required in order to eliminate uneven application or unsightly drippings. The roller should be kept damp with manufacturer's approved solvent to avoid picking up sprayed material from surface.
   3. Where recommended by manufacturer or where required for a neat, smooth final coat, roll with a smooth or short nap roller applying light pressure to the surface.
   4. Apply nonintumescent topcoats where scheduled, using materials and application methods according to manufacturer's written instructions.

I. **Completed Work:**
   1. Verify compatibility of decorative top coat with intumescent paint system and UL listing as indicated on Drawings. Apply only coatings that will not adversely impact the fire resistive properties of intumescent products.
   2. Match approved samples for color, texture, and coverage. Removed, refinish, or repaint work not complying with specified requirements.

## 3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
   1. The Owner will engage the services of an independent testing agency to sample paint materials being used. Samples of material delivered to the Project site will be taken, identified, sealed, and certified in the presence of the Contractor.
   2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
      a. Qualitative material analysis.
      b. Absorption.
      c. Accelerated weathering.
      d. Accelerated yellowness.
      e. Color retention.
      f. Alkali resistance.
      g. Abrasion resistance.

h. Mildew resistance.
i. Apparent reflectivity.
j. Washability.
k. Dry opacity.
l. Recoating.
m. Skinning.

3. The **Owner may direct the Contractor to stop painting** if test results show materials being used do not comply with specified requirements. The Contractor shall remove noncomplying paint materials from the Project site, pay for testing, and repaint surfaces previously painted with rejected materials. If necessary, the Contractor may be required to remove rejected materials from previously painted surfaces if, on repainting with the specified materials, the two coatings are incompatible.

## 3.5 CLEANING

A. **Clean Up:** At the end of each workday, remove rubbish, empty cans, rags, and other discarded materials from the Project site.
   1. After completing painting, clean glass and paint spattered surfaces. Remove spattered paint by proper methods. Be careful not to scratch or otherwise damage adjacent 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 the Architect. Leave the work in an undamaged condition.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. After completing work of other trades, touch up and restore damaged or defaced surfaces. Comply with PDCA P1.

## 3.7 INTUMESCENT PAINT SCHEDULE

A. **Interior Ferrous Metal - HSS Columns**: Provide the following intumescent paint systems over interior ferrous-metal surfaces to provide 2 hour protection of steel:
   1. **Finish: Two coats over a primer.**
      a. **Prime Coat:** Latex-type primers applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm).
         1) AD: Metal primer as approved by AD and compatible with UL design number.
         2) Albi: 490W Corrosion Resistant Metal Primer.
      b. **Fireproofing Coat:** Flat, intumescent-type, fire-retardant, latex paint applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness sufficient to meet the UL Design number noted on the Drawings.
         1) AD: A/D Firefilm III.
         2) Albi: Albi-Clad TF Latex Flat Interior finish.
      c. **Reinforcement:** Where required by the UL Design Number, embed fiberglass ribbon in the midpoint of the fireproofing coat. Fiberglass shall not be visible through finish coat.

d. **Decorative Top Coat:** Coating applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm) and as required to completely cover base coat and to provide a uniform color. Apply multiple coats as needed.
   1) AD: A/D Colorcoat, silicone alkyd paint. Color and sheen to match that indicated in Finish Schedule.
   2) Albi: Product approved by intumescent manufacturer and providing the color(s) and sheen level indicated in Finish Schedule.

B. **Interior Ferrous Metal - Beams:** Provide the following intumescent paint systems over interior ferrous-metal surfaces to provide 2 hour protection of steel:
   1. **Finish: Two coats over a primer.**
      a. **Prime Coat:** Latex-type primers applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm).
         1) AD: Metal primer as approved by AD and compatible with UL design number.
         2) Albi: 490W Corrosion Resistant Metal Primer.
      b. **Fireproofing Coat:** Flat, intumescent-type, fire-retardant, latex paint applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness sufficient to meet the UL Design number noted on the Drawings.
         1) AD: Carboline Thermo-Lag 3000A
      c. **Reinforcement:** Where required by the UL Design Number, embed fiberglass ribbon in the midpoint of the fireproofing coat. Fiberglass shall not be visible through finish coat.
      d. **Decorative Top Coat:** Coating applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm) and as required to completely cover base coat and to provide a uniform color. Apply multiple coats as needed.
         1) AD: A/D Colorcoat, silicone alkyd paint. Color and sheen to match that indicated in Finish Schedule.
         2) Albi: Product approved by intumescent manufacturer and providing the color(s) and sheen level indicated in Finish Schedule.

C. **Exterior Galvanized Ferrous Metal:** Provide the following intumescent paint systems over galvanized ferrous-metal surfaces to provide 2 hour protection of steel:
   1. **Finish: Two finish coats over a primer.**
      a. **Prime Coat:** Approved primers applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm).
         1) AD: Metal primer as approved by AD/Carboline and compatible with UL design number.
         2) Iso/Cafco: Metal primer as approved by Isolatek and compatible with UL design number.
      b. **Fireproofing Coat:** Intumescent-type, fire-retardant, paint applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness sufficient to meet the requirements of the UL Design number noted on the Drawings.
         1) AD: Carboline Thermo-Lag 3000A.
         2) Iso/Cafco: SprayFilm WB4, water-based.

c. **Protective Seal Coat:** Coating applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm).
   1) AD: Carboguard 1340 (or Rustbond) plus Carbothane 133 HB
   2) Iso/Cafco: Spray-Film Topseal (epoxy)

d. **Decorative Top Coat:** Semi-gloss finish top coat, in color as scheduled. Product as approved by intumescent coating manufacturer and compatible with the requirements of the selected UL Design Number. Apply paint at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils (0.1 mm) and as required to completely cover base coat and to provide a uniform color. Apply multiple coats as needed.
   1) AD: Product approved by intumescent manufacturer.
   2) Iso/Cafco: Tnemec Endura-Shield 73, aliphatic acrylic polyurethane, or Sherwin-Williams Acrolon 218HS.
      (a) Apply number of coats necessary to achieve uniform color.

**END OF SECTION**

## SECTION 07 8400

## THROUGH-PENETRATION FIRESTOP SYSTEMS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes through-penetration firestop systems** for penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
   1. **Floors**.
   2. **Roofs**.
   3. **Walls** and **partitions**.
   4. **Smoke** barriers.
   5. **The work of this section shall include**, **but not be limited to:**
      a. **All clips** and other restraining devices necessary for holding fire protection material in place.
      b. **Other items necessary** for a **complete and integral installation** thru out the entire perimeter and other penetrations.

B. **Related Sections** include the following:
   1. **Division 7** Section "**Fire-Resistive Joint Systems**."
   2. **Divisions 21 thru 23** Sections specifying **duct** and **piping penetrations**.
   3. **Divisions 26 thru 28** Sections specifying **cable** and **conduit penetrations**.

### 1.3 PERFORMANCE REQUIREMENTS

A. **General**: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. **Fire-resistance-rated walls** including fire walls, fire partitions, fire barriers, and smoke barriers.
   2. **Fire-resistance-rated horizontal assemblies** including floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

B. **Rated Systems**: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
   1. **F-Rated Systems**: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. **T-Rated Systems**: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
      a. Penetrations located outside wall cavities.
      b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. **L-Rated Systems**: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 deg F (204 deg C).

C. **For through-penetration firestop systems exposed to view**, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. **For through-penetration firestop systems exposed to view**, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

## 1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Shop Drawings**: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. **Through-Penetration Firestop System Schedule**: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. **Qualification Data**: For Installer.

E. **Product Test Reports**: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. **Installation Responsibility**: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. **Source Limitations**: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. **Fire-Test-Response Characteristics**: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. **Firestopping tests** are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. **Through-penetration firestop systems** are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
      a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
      b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
         1) UL in its "Fire Resistance Directory."

E. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

## 1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. **Ventilate through-penetration firestop systems** per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Products**: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated that are produced by one of the following manufacturers:
1. **Grace**, W. R. & Co. - Conn.
2. **Hilti,** Inc.
3. **Nelson** Firestop Products.
4. **3M;** Fire Protection Products Division.
5. **Tremco**; Sealant/Weatherproofing Division.

### 2.2 FIRESTOPPING, GENERAL

A. **Compatibility**: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. **Accessories**: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

C. **Accessories include,** but are not limited to, the following items:
1. **Permanent forming/damming/backing materials**, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. **Temporary forming** materials.
3. **Substrate** primers.
4. **Collars**.
5. **Steel sleeves**.

### 2.3 FILL MATERIALS

A. **General**: Provide through-penetration firestop systems containing the types of fill materials indicated. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. **Cast-in-Place Firestop Devices**: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. **Latex Sealants**: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. **Firestop Devices**: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. **Mortars**: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

F. **Pillows/Bags**: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

G. **Silicone Foams**: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

H. **Silicone Sealants**: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. **Grade:** Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

## 2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates and conditions**, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Surface Cleaning**: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. **Priming**: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. **Masking Tape**: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

## 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. **General**: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. **Install forming/damming/backing materials** and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. **Install fill materials** for firestop systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

## 3.4 IDENTIFICATION

A. **Identify through-penetration firestop systems** with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
1. The words "**Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage**."
2. Contractor's name, address, and phone number.

3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

## 3.5 FIELD QUALITY CONTROL

A. **Inspecting Agency**: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. **Where deficiencies are found**, repair or replace through-penetration firestop systems so they comply with requirements.

C. **Proceed** with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

## 3.6 CLEANING AND PROTECTING

A. **Clean off excess fill materials** adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. **Provide final protection** and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

**END OF SECTION**

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## SECTION 07 8443

## FIRE-RESISTANT JOINT SEALANTS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

### 1.2 DEFINITIONS

A. **Firestopping**: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

### 1.3 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

A. **Only tested and listed firestop systems shall be used** in specific locations as follows:
1. Safing slot gaps between edge of floor slabs and perimeter curtain walls.
2. Openings between structurally separate sections of wall or floors.
3. Gaps between the top of walls and ceilings or roof assemblies.
4. Expansion joints in walls and floors.
5. Anywhere indicated on Drawings.

### 1.4 RELATED WORK OF OTHER SECTIONS

A. **Coordinate work of this section** with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
1. **Division 3** Section "**Cast-In-Place Concrete**"
2. **Division 7** Section "**Through-Penetration Firestop Systems**"
3. **Division 7** Section "**Joint Sealants**"
4. **Division 8** Section "**Aluminum Entrances and Storefronts**"
5. **Division 8** Section "**Glazed Aluminum Curtain Walls**"
6. **Division 9** Section "**Gypsum Board**"
7. **Division 9** Section "**Gypsum Sheathing**"

### 1.5 REFERENCES

A. **Underwriters Laboratories**, Inc. (UL) Fire Resistance Directory, Volume II, updated Annually:
1. Joint Systems (XHBN)
2. Perimeter Fire Containment Systems (XHDG)
3. Fire Resistance Ratings (BXRH)
4. Fill, Voids, or Cavity Material (XHHW)
5. Forming Materials (XHKU)

B. **Omega Point Laboratories** (Intertek ITL Semko):
1. Fire Resistant Joint Systems

C. **ASTM International**

1. ASTM E 1966, “Standard Test Method for Fire-Resistive Joint Systems”
2. ASTM E 1399, “Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Width of Architectural Joint Systems”
3. ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials”
4. ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops”
5. ASTM E 2307, “Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus”

D. **ANSI/UL 2079**, “Tests for Fire Resistance of Building Joint Systems”

E. **International Firestop Council** (IFC) "Recommended (IFC) Guidelines for Evaluating Firestop Systems Engineering Judgments".

F. **IBC 2009**, as enforced by the State of Utah.

G. **NFPA 101** - Life Safety Code

## 1.6 QUALITY ASSURANCE

A. A **manufacturer's direct representative** (not distributor or agent) **to be on-site** during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

B. **Firestop System installation** shall meet requirements of ASTM E 1966 or ANSI/UL 2079 tested and listed assemblies that provide fire-resistance ratings not less than that of the construction in which the joint occurs.

C. Proposed **firestop materials and methods shall conform to applicable governing codes** having local jurisdiction.

D. **Firestop Systems do not reestablish the structural integrity** of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the Structural Engineer prior to penetrating any load bearing assembly.

E. For those firestop applications that exist for which no tested and listed system is available through a manufacturer, **an engineering judgment derived from similar tested and listed system designs or other tests will be submitted** to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings shall follow requirements set forth by the International Firestop Council.

## 1.7 SUBMITTALS

A. **Product Data**: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of tested and listed firestop systems to be used and manufacturer's installation instructions to comply with Section 01 30 00 Submittal Procedures.

B. **Manufacturer's engineering judgment identification number and drawing details** when no tested and listed system is available for an application. Engineering judgment shall include both project name and contractor's name who will install firestop system as described in drawing.

C. Submit **material safety data sheets** provided with product delivered to job-site.

D. **Deferred Submittal:** To be submitted to the Building Code Official for review.

## 1.8 INSTALLER QUALIFICATIONS

A. **Engage an experienced Installer** who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. **Deliver materials undamaged** in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL or OPL label, where applicable.

B. **Coordinate delivery of materials** with scheduled installation date to allow minimum storage time at job-site.

C. **Store materials under cover** and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.

D. **Comply with recommended procedures**, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

## 1.10 PROJECT CONDITIONS

A. **Do not use materials that contain flammable solvents**.

B. **Schedule installation** of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

C. **Verify existing conditions and substrates** before starting work. Correct unsatisfactory conditions before proceeding.

D. **Weather conditions**: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, **provide masking and drop cloths** to prevent firestopping materials from contaminating any adjacent surfaces.

## PART 2 - PRODUCTS

### 2.1 FIRESTOPPING, GENERAL

A. Provide f**irestopping composed of components that are compatible with each other** and substrates forming joints under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

B. Provide **components for each fire-resistive joint system that are needed to install fill material**. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

### 2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory or OPL Listed Products Directory; provide products of the following manufacturers as identified below:
1. **Hilti**, Inc., Tulsa (Basis of Design); www.us.hilti.com
2. **Nelson** Firestop Products; www.nelsonfirestop.com
3. **3M;** Fire Protection Products Division; www.solutions.3m.com
4. **Tremco**; Sealant/Weatherproofing Division; www.tremcosealants.com

### 2.3 MATERIALS

A. Use only firestop products that have been tested in accordance with ASTM E 1966 or ANSI/UL 2079 for specific rated construction conditions conforming to construction assembly type, movement capability, spacing requirements, and fire-resistance-rating involved for each separate instance.

B. *Sealants for use with fire-resistance-rated construction joints*, Basis of Design products:
1. Hilti CP 672 Speed Spray
2. Hilti CP 601s Elastomeric Firestop Sealant
3. Hilti CP 606 Flexible Firestop Sealant
4. Hilti CP 604 Self-leveling Firestop Sealant

C. **Sealants for use as part of a Perimeter Fire Barrier System** between fire-resistance-rated floors and exterior wall assemblies, Basis of Design products:
1. Hilti CFS SP WB Firestop Joint Spray
2. Hilti CP 604 Self-leveling Firestop Sealant

D. **Pre-formed mineral wool designed to fit flutes of metal profile deck** and gap between top of wall and metal deck profile; use as a backer for spray material.
1. Basis of Design Products:
   a. Hilti CP 777 Speed Plugs
   b. Hilti CP 767 Speed Strips

E. **Provide a firestop system with an Assembly Rating as determined by ASTM E 1966 or ANSI/UL 2079** which is equal to the fire-resistance ratings of the construction in which the joint occurs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **Verification of Conditions:** Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
   1. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
   2. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
   3. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
   4. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. **Regulatory Requirements:** Install firestop materials in accordance with UL Fire Resistance Directory or Omega Point Laboratories Listed Products Directory.

B. **Manufacturer's Instructions:** Comply with manufacturer's instructions for installation of construction joint materials.
   1. Protect materials from damage on surfaces subjected to traffic.

### 3.3 FIELD QUALITY CONTROL

A. **Examine sealed joints** to ensure proper installation before concealing or enclosing areas.

B. **Keep areas of work accessible** until inspection by applicable code authorities and/or independent inspection agency.

C. **Perform under this section patching and repairing** of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

### 3.4 ADJUSTING AND CLEANING

A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

B. **Clean all surfaces** adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

**END OF SECTION**

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# SECTION 07 9200

# JOINT SEALANTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** sealants for the following applications, including those specified by reference to this Section:
   1. **Exterior joints** in the following vertical surfaces and non-traffic horizontal surfaces:
      a. Control and expansion joints in **cast-in-place concrete**.
      b. Control and expansion joints in **unit masonry**.
      c. Joints in metal **panel systems**.
      d. Joints between **different materials** listed above.
      e. **Perimeter joints** between materials listed above and frames of doors and windows.
      f. Control and expansion joints in **soffit** and **overhead surfaces**.
      g. **Other joints** as indicated.
   2. **Exterior joints** in the following horizontal **traffic surfaces**:
      a. **Control, expansion**, and isolation joints in cast-in-place concrete slabs.
      b. **Tile control** and expansion joints.
      c. Joints between **different materials** listed above.
   3. **Interior joints** in the following vertical surfaces and horizontal **nontraffic** surfaces:
      a. **Control and expansion joints** on exposed interior surfaces of exterior walls
      b. **Perimeter joints** of exterior openings where indicated.
      c. **Control** and **expansion joints** in **ceiling** and **overhead surfaces**.
      d. **Tile control** and expansion joints.
      e. **Vertical control joints** on exposed surfaces of interior unit masonry and concrete walls and partitions.
      f. **Perimeter joints** between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      g. **Joints between plumbing fixtures** and adjoining walls, floors, and counters.
      h. **Joints between interior partitions** and concrete floors.
      i. **Other joints** as indicated.
   4. **Interior joints** in the following horizontal **traffic** surfaces:
      a. **Control and expansion** joints in cast-in-place **concrete** slabs.
      b. **Control and expansion** joints in **tile** flooring.
      c. **Other joints** as indicated.
   5. **All joints** between dissimilar materials.

B. **Related Sections** include the following:
   1. **Division 4** Section "**Unit Masonry Assemblies**" for masonry control and expansion joint filers and gaskets.
   2. **Division 7** Section "**Firestopping**" for fire-resistant building joint-sealant systems.

3. **Division 9** Section "**Gypsum Board**" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. **Division 9** Section "**Acoustical Panel Ceilings**" for sealing edge moldings at perimeters of acoustical ceilings.

## 1.3 PERFORMANCE REQUIREMENTS

A. **Provide elastomeric joint sealants** that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

## 1.4 SUBMITTALS

A. **Product Data**: For each joint-sealant product indicated.

B. **Samples for Selection**: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. **Product Certificates**: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

## 1.5 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. **Preconstruction Compatibility and Adhesion Testing**: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. **Use manufacturers standard test methods** to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   a. **Perform tests** under environmental conditions replicating those that will exist during installation.
2. **Submit not fewer than nine pieces** of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. **Schedule sufficient time** for testing and analyzing results to prevent delaying the Work.
4. **For materials failing tests**, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. **Testing will not be required if** joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. **Mockups**: Before installing joint sealants, apply elastomeric sealants as follows to verify color selections and to demonstrate aesthetic effects and qualities of materials and execution:

1. **Joints in mockups** of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver materials** to 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.

## 1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not proceed with installation of joint sealants under the following conditions:
   1. **When ambient and substrate temperature** conditions are outside limits permitted by joint sealant manufacturer.
   2. **When joint substrates** are **wet**.

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.

## 1.8 WARRANTY

A. **Special Installer's Warranty**: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. **Warranty Period**: **Three years** from date of Substantial Completion.

B. **Special Manufacturer's Warranty**: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. **Warranty Period**: **Ten years** from date of Substantial Completion.

C. **Special warranties** specified in this Article **exclude** deterioration or failure of elastomeric joint sealants from the following:
   1. **Movement of the structure** resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. **Disintegration of joint substrates** from natural causes exceeding design specifications.
   3. **Mechanical damage** caused by individuals, tools, or other outside agents.
   4. **Changes in sealant appearance** caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 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. **Colors of Exposed Joint Sealants**: **Custom** as selected by Architect.

### 2.2 ELASTOMERIC JOINT SEALANTS

A. **Elastomeric Sealant Standard**: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. **Additional Movement Capability**: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. **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.

### 2.3 SOLVENT-RELEASE JOINT SEALANTS

A. **Acrylic-Based Solvent-Release Joint-Sealant Standard**: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

B. **Butyl-Rubber-Based Solvent-Release Joint-Sealant Standard**: Comply with ASTM C 1085 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

### 2.4 LATEX JOINT SEALANTS

A. **Latex Sealant Standard**: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

### 2.5 ACOUSTICAL JOINT SEALANTS

A. **Acoustical Sealant for Exposed and Concealed Joints**: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

## 2.6 JOINT-SEALANT BACKING

A. **General**: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint filers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. **Cylindrical Sealant Backings**: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. **Type C**: Closed-cell material with a surface skin.

D. **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 (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

E. **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.

## 2.7 MISCELLANEOUS MATERIALS

A. **Primer**: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. **Cleaners for Nonporous Surfaces**: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. **Masking Tape**: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. All joints of **dissimilar materials** to receive joint sealant.

B. **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.

C. **Proceed with installation** only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Surface Cleaning of Joints**: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. **Remove all foreign material** from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. **Clean porous joint substrate surfaces** by brushing, grinding, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include concrete, masonry or unglazed surfaces of ceramic tile.
3. **Remove laitance** and form-release agents from concrete.
4. **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 to metal, glass, porcelain enamel or glazed surfaces of ceramic tile.

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 OF JOINT SEALANTS

A. **General**: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. **Sealant Installation Standard**: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. **Acoustical Sealant Application Standard**: Comply with recommendations of 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 back of joints.

F. **Install sealants** by proven techniques to 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 provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
   4. Seal abutting joint at all dissimilar materials.

G. **Tooling of Nonsag 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 sealants** from surfaces adjacent to joint.
   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.
   4. **Provide flush joint configuration**, per Figure 5B in ASTM C 1193, where indicated.
   5. **Provide recessed joint configuration**, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
      a. **Use masking tape** to protect adjacent surfaces of recessed tooled joints.

## 3.4 CLEANING

A. **Clean off excess sealants** 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.

## 3.5 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 areas are indistinguishable from the original work.

## 3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. **Medium-Modulus Neutral-Curing Silicone Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. **Products:**
      a. **791;** Dow Corning.
      b. **PSI-631;** Polymeric Systems, Inc.
      c. **Sonolastic 150**, Sonneborn
      d. **Spectrem 2**; Tremco.
   2. **Type and Grade**: S (single component) and NS (nonsag).
   3. **Class**: 25.
   4. **Use Related to Exposure**: NT (nontraffic).

5. **Uses Related to Joint Substrates**: M (masonry), G (glass), A (aluminum), and, as applicable to joint substrates indicated, O (other).
   a. **Use O Joint Substrates**: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
6. **Stain-Test-Response Characteristics**: Nonstaining to porous substrates per ASTM C 1248.
7. **Applications**: Exterior and interior joints in vertical surfaces of concrete; between metal and concrete and mortar; perimeter of metal frames in exterior walls; overhead or ceiling joints.

B. **Mildew-Resistant Silicone Sealant**: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
1. **Products**:
   a. **786** Mildew Resistant; Dow Corning.
   b. **Omniplus**, Sonneborn.
   c. **Sanitary 1700**; GE Silicones.
   d. **Tremsil 600** White; Tremco.
   e. **Sonolastic 150**, Sonneborn
2. **Type and Grade**: S (single component) and NS (nonsag).
3. **Class**: 25.
4. **Use Related to Exposure**: NT (nontraffic).
5. **Uses Related to Joint Substrates**: G, A, and, as applicable to joint substrates indicated, O.
   a. **Use O Joint Substrates**: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
6. **Applications**: Interior joints in vertical surfaces of ceramic tile in toilet rooms, and showers.

C. **Multicomponent Pourable Urethane Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
1. **Products**:
   a. **Vulkem 245**; Mameco International.
   b. **Elasto-Thane 920** Pourable; Pacific Polymers, Inc.
   c. **Sikaflex - 2c SL**; Sika Corporation.
   d. **SL 2**; Sonneborn Building Products Div., ChemRex Inc.
2. **Type and Grade**: M (multicomponent) and P (pourable).
3. **Class**: 25.
4. **Uses Related to Exposure**: T (traffic) and NT (nontraffic).
5. **Uses Related to Joint Substrates:** M, A, and, as applicable to joint substrates indicated, O.
   a. **Use O Joint Substrates**: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
6. **Applications**: **Traffic joints**.

D. **Single-Component Nonsag Urethane Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
1. **Products**:
   a. **Vulkem 921**; Mameco International.
   b. **Dynatrol I;** Pecora Corporation.
   c. **DyMonic**; Tremco.
   d. **NP1**, Sonneborn.

2. **Type and Grade**: S (single component) and NS (nonsag).
3. **Class**: 25
4. **Use Related to Exposure**: NT (nontraffic).
5. **Uses Related to Joint Substrates**: M, A, and, as applicable to joint substrates indicated, O.
   a. **Use O Joint Substrates**: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
6. **Applications**: **Joints in concrete**.

## 3.7 LATEX JOINT-SEALANT SCHEDULE

A. **Latex Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. **Products**:
      a. **AC-20**; Pecora Corporation.
      b. **Sonolac**; Sonneborn Building Products Div., ChemRex, Inc.
      c. **Tremflex 834**; Tremco.
   2. **Applications**: Interior joints in field-painted vertical and overhead surfaces at hollow metal door frames, gypsum drywall, and concrete; and all other interior locations not indicated otherwise.

## 3.8 ACOUSTICAL JOINT-SEALANT SCHEDULE

A. **Acoustical Sealant for Exposed and Concealed Joints**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. **Products**:
      a. **AC-20 FTR** Acoustical and Insulation Sealant; Pecora Corporation.
      b. **SHEETROCK** Acoustical Sealant; USG Corp., United States Gypsum Co.
   2. **Applications**: Use in locations of **sound walls** and in locations indicated.

## 3.9 SMOKE AND ACOUSTIC SEALANT

A. **Smoke** and **Acoustical Sealant** for Joints between **metal decks** and **walls** (non-fire rated): Where joint sealants of this type are indicated, provide products complying with the following:
   1. **Products** (where flutes are **parallel** to the wall):
      a. Provide **CP767 Speed Strips** pre-formed mineral wool plugs by **Hilti** if required.
      b. **CP 506** Smoke and Acoustic Sealant; Hilti.
   2. **Products** (where flutes are **perpendicular** to the wall):
      a. Provide **CP777 Speed Strips** pre-formed mineral wool plugs by **Hilti.** Press into flutes.
      b. **CP 572** Smoke and Acoustic Sealant; Hilti.

**END OF SECTION**

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# DIVISION 8 - DOORS AND WINDOWS


| | |
|---|---|
| Section 08 1100 | Hollow Metal Doors and Frames |
| Section 08 1400 | Flush Wood Doors |
| Section 08 3100 | Access Doors and Frames |
| Section 08 3323 | Overhead Coiling Doors |
| Section 08 4100 | Aluminum Entrances and Storefronts |
| Section 08 4329 | Sliding Automatic Entrance Doors |
| Section 08 4416 | Glazed Aluminum Curtain Walls |
| Section 08 6200 | Insulated Translucent Panel System |
| Section 08 6220 | Tubular Skylights |
| Section 08 7100 | Door Hardware |
| Section 08 8000 | Glazing |
| Section 08 8300 | Mirrored Glass |
| Section 08 8800 | Decorative Glass |

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# SECTION 08 1100

# HOLLOW METAL DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Section Includes**:
1. Steel **doors**.
2. **Single rabbeted** hollow metal **doors** and **window** frames.
3. **Fire rated** doors and frame assemblies.

B. **Related Sections**
1. **Division 4** Section "**Unit Masonry Assemblies**" for embedding anchors for hollow metal work into masonry construction.
2. **Division 8** Section **"Flush Wood Doors"** for wood doors installed in steel frames.
3. **Division 8** Section "**Door Hardware**" for door hardware for hollow metal doors.
4. **Division 8** Section "**Glazing**" for glass in glazed openings.
5. **Division 9** Section "**Gypsum Board Assemblies**" for spot grouting frames installed in steel framed gypsum board partitions
6. **Division 9** Sections "**Painting**" for field painting hollow metal doors and frames.

### 1.3 DEFINITIONS

A. **Minimum Thickness**: Minimum thickness of base metal without coatings.

B. **Standard Hollow Metal Work**: Hollow metal work fabricated according to ANSI/SDI A250.8.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. **Shop Drawings**: Include the following:
1. Elevations of each door and window frame design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. **Other Action Submittals**:
   1. **Schedule:** Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. **Oversize Construction Certification**: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

E. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

## 1.5 QUALITY ASSURANCE

A. **Source Limitations**: Obtain hollow metal work from single source from single manufacturer.

B. **Fire-Rated Door Assemblies**: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
   1. **Oversize Fire-Rated Door Assemblies**: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
   2. **Temperature-Rise Limit:** Where indicated, but not limited to, vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. **Fire-Rated, Borrowed-Light Frame Assemblies**: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to finish of factory-finished units.

B. **Deliver welded frame**s with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. **Store hollow metal work under cover at Project site**. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-(102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
   1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## 1.7 PROJECT CONDITIONS

A. **Field Measurements**: Verify actual dimensions of openings by field measurements before fabrication.

## 1.8 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. Deliver such items to Project site in time for installation.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. **Amweld** Building Products, LLC.
2. **Ceco** Door Products; an Assa Abloy Group company.
3. **Curries** Company; an Assa Abloy Group company.
4. **Pioneer** Industries, Inc.
5. **Steelcraft**; an Ingersoll-Rand company.
6. **Republic** Doors and Frames.
7. **Security Metal** Products Corp.

## 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; free of scale, pitting, or surface defects; pickled and oiled.

C. **Metallic-Coated Steel Sheet**: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.

D. **Frame Anchors:** ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. **Inserts, Bolts, and Fasteners:** Hot-dip galvanized according to ASTM A 153/A 153M.

F. **Powder-Actuated Fasteners in Concrete**: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. **Grout:** ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. **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. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. **Glazing:** Comply with requirements in Division 8 Section "Glazing."

J. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.3 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 ANSI/SDI A250.8.
   1. **Design:** Flush panel.
   2. **Core Construction**: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
      a. **Fire Door Core:** As required to provide fire-protection and temperature-rise ratings indicated.
      b. **Thermal-Rated (Insulated) Doors**: Where indicated, provide doors fabricated with thermal-resistance value (**R-value**) of not less than **12.3** deg F x h x sq. ft./Btu (2.166 K x sq. m/W) when tested according to ASTM C 1363.
         1) **Locations**: All exterior doors and interior doors where indicated.
   3. **Vertical Edges for Single-Acting Doors**: Beveled edge.
      a. **Beveled Edge**: 1/8 inch in 2 inches (3 mm in 50 mm).
   4. **Top and Bottom Edges**: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
   5. **Tolerances:** Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. **Exterior Doors:** Face sheets fabricated from metallic-coated 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 performance level:
   1. **Level 4** and Physical Performance Level A (Maximum Duty), **Model 2** (Seamless) (**14 gauge** face).

C. **Interior Doors:** Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. **Level 2** and Physical Performance **Level A** (**Heavy Duty**), **Model 2** (Seamless) (**18 gauge** face).

D. **Hardware Reinforcement:** Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

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.
   1. Frames to be **single rabbeted** as indicated on the Drawings.

B. **Exterior Frames**: Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with **mitered** or coped corners.
   2. Fabricate frames as **face welded** unless otherwise indicated.
   3. Frames for **Level 4** Steel Doors: **14 gauge** 0.067-inch- (1.7-mm-) thick steel sheet.

C. **Interior Frames:** Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
   1. Fabricate frames with **mitered** or **coped** corners.
   2. Fabricate frames as **face welded** unless otherwise indicated.
   3. Frames for **Level 2** Steel Doors: **16 gauge** 0.053-inch- (1.3-mm-) thick steel sheet.
   4. **Frames for Wood Doors**: **16 gauge** 0.053-inch- (1.3-mm-) thick steel sheet.
   5. **Frames for Borrowed Lights**: **16 gauge** 0.053-inch- (1.3-mm-) thick steel sheet.

D. **Hardware Reinforcement**: Fabricate according to **ANSI/SDI A250.6** with reinforcement plates from same material as frames.

## 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 **19 gauge** 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than **26 gauge** 0.177 inch (4.5 mm) thick.
   2. **Stud-Wall Type**: Designed to engage stud, welded to back of frames; not less than **19 gauge** 0.042 inch (1.0 mm) thick.
   3. **Postinstalled Expansion Type for In-Place Concrete or Masonry**: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. **Floor Anchors:** Formed from same material as frames, not less than 19 gauge 0.042 inch (1.0 mm) thick, and as follows:
   1. **Monolithic Concrete Slabs**: Clip-type anchors, with two holes to receive fasteners.

## 2.6 STOPS AND MOLDINGS

A. **Moldings for Glazed Lites in Doors**: Minimum **21 gauge** 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. **Fixed Frame Moldings**: Formed integral with hollow metal frames, a minimum of **5/8 inch** (16 mm) high unless otherwise indicated.

C. **Loose Stops for Glazed Lites in Frames:** Minimum **21 gauge** 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

## 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- (6.4-mm-thick by 25.4-mm-) wide steel.

C. **Grout Guards:** Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

## 2.8 FABRICATION

A. **Fabricate hollow metal work** to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for 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 SDI 117.

C. **Hollow Metal Doors**:
1. **Exterior Doors**: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. **Glazed Lites:** Factory cut openings in doors.
3. **Astragals:** Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.

D. **Hollow Metal Frames**: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. **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**: Weld guards to frame at back of hardware mortises in frames to be grouted.
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 (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      1) Two anchors per jamb up to 60 inches (1524 mm) high and one floor anchor.
      2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high and one floor anchor.
      3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high and one floor anchor.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
   b. **Stud-Wall Type:** Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

1) Three anchors per jamb up to 60 inches (1524 mm) high.
2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.

c. **Compression Type:** Not less than two anchors in each jamb.

d. **Postinstalled Expansion Type:** Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

7. **Door Silencers:** Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. **Single-Door Frames:** Drill stop in strike jamb to receive three door silencers.

b. **Double-Door Frames**: Drill stop in head jamb to receive two door silencers.

E. **Fabricate concealed stiffeners**, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. **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. **Locate hardware as indicated**, or if not indicated, according to ANSI/SDI A250.8.
2. **Reinforce doors** and **frames** to receive nontemplated, mortised and surface-mounted door hardware.
3. **Comply** with applicable requirements in **ANSI/SDI A250.6** and **ANSI/DHI A115 Series** specifications for preparation of hollow metal work for hardware.
4. **Coordinate locations of conduit** and wiring boxes for electrical connections with **Division 26 Sections**.
5. **Provide auxiliary hinge reinforcement** at all hinge locations on every frame.

G. **Stops and Moldings**: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. **Single Glazed Lites:** Provide fixed stops and moldings welded on secure side of hollow metal work.
2. **Multiple Glazed Lites**: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. **Provide fixed frame moldings** on outside of exterior and on secure side of interior doors and frames.
4. **Provide loose stops and moldings** on inside of hollow metal work.
5. **Coordinate rabbet** width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.9 STEEL FINISHES

A. **Prime Finish:** Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. **Shop Primer:** Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings 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 the Work.

B. **Examine roughing-in** for embedded and built-in anchors to verify actual locations before frame installation.

C. **For the record, prepare written report,** endorsed by Installer, listing conditions detrimental to performance of the Work.

D. **Proceed with installation** only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Remove welded-in shipping spreaders** installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. **Prior to installation**, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. **Squareness:** Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. **Alignment:** Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   3. **Twist:** Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. **Plumbness:** Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. **Drill and tap doors and frames** to receive nontemplated, mortised, and surface-mounted door hardware.

## 3.3 INSTALLATION

A. **General:** Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. **Hollow Metal Frames**: Install hollow metal frames of size and profile 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** because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. **Install frames** with removable glazing stops located on **secure side** of opening.
   d. **Install door silencers** in frames before grouting.
   e. **Remove temporary braces** necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. **Field apply bituminous coating** to backs of frames that are filled with grout containing antifreezing agents.
2. **Floor Anchors**: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. **Floor anchors** may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. **Metal-Stud Partitions:** Solidly pack mineral-fiber insulation behind frames.
4. **Masonry Walls:** Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. **Concrete Walls**: Solidly fill space between frames and concrete with 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 postinstalled 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 postinstalled 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 (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. **Alignment:** Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. **Twist:** Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. **Plumbness:** Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. **Hollow Metal Doors**: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. **Non-Fire-Rated Standard Steel Doors**:
   a. **Jambs and Head:** 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. **Between Edges of Pairs of Door**s: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. **Between Bottom of Door and Top of Threshold**: Maximum 3/8 inch (9.5 mm).
   d. **Between Bottom of Door and Top** of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
2. **Fire-Rated Doors:** Install doors with clearances according to NFPA 80.

D. **Glazing:** Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. **Secure stops with countersunk flat- or oval-head machine screws** spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

## 3.4 ADJUSTING AND CLEANING

A. **Final Adjustments:** Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. **Remove grout** and other bonding material from hollow metal work immediately after installation.

C. **Prime-Coat Touchup**: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. **Metallic-Coated Surfaces:** Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

**END OF SECTION**

# SECTION 08 1400

# FLUSH WOOD DOORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. **Solid-core** doors with wood-veneer faces.
2. **Factory finishing** flush wood doors.
3. **Fire rated** wood doors.

B. **Related Sections** include the following:
1. **Division 8** Section "**Glazing**" for glass view panels in flush wood doors.

### 1.3 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.
1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire ratings for fire doors.

C. **Samples for Selection**: Color charts consisting of actual materials in small sections for the following:
1. **Faces of Factory-Finished Doors**: Show the full range of colors available for stained finishes.

### 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain flush wood doors through one source from a single manufacturer.

B. **Quality Standard**: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

C. **Fire-Rated Wood Doors**: Doors complying with **NFPA 80** that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to **NFPA 252**.

1. **Test Pressure**: Test at atmospheric pressure.
2. **Temperature-Rise Rating**: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Comply** with requirements of referenced standard and manufacturer's written instructions.

B. **Package doors individually** in plastic bags or cardboard cartons.

C. **Mark each door on top and bottom rail** with opening number used on Shop Drawings.

## 1.6 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.

## 1.7 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 (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span.
1. **Warranty** shall be in effect during the following period of time from date of Substantial Completion:
   a. **Solid-Core Interior Doors**: **Life of installation**.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. **Flush Wood Doors**:
   a. **Algoma** Hardwoods Inc.
   b. **Eggers** Industries; Architectural Door Division.
   c. **Graham** Manufacturing Corp.
   d. **Oshkosh** Architectural Door Co.
   e. **VT Industries** Inc.
   f. **Marshfield** Door Systems, Inc.

## 2.2 DOOR CONSTRUCTION, GENERAL

A. **Doors for Transparent Finish**:
1. **Grade: Premium**, with **Grade A** faces.
2. **Species and Cut**: **Select white maple**, quarter sliced (straight grain).
3. **Match between Veneer Leaves**: Book match.
4. **Assembly of Veneer Leaves on Door Faces:** Running match.

5. **Pair and Set Match**: Provide for doors hung in same opening or separated only by mullions.
6. **Room Match**: Provide door faces of compatible color and grain within each separate room or area of building.
7. **Stiles:** Same species as faces.
8. **The door construction** should be such that no **urea-formaldehyde resin** is used.

## 2.3 SOLID-CORE DOORS

A. **Particleboard Cores**: Comply with the following requirements:
1. **Particleboard**: ANSI A208.1, **Grade LD-2** (Note: The **LD-2** grade calls for particle board with enough pull out resistance so that blocking for hardware is not required.)

B. **Interior Veneer-Faced Doors:**
1. **Core**: Particleboard, Grade LD-2
2. **Construction**: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. **Fire-Rated Doors**:
1. **Construction**: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated. Comply with **NFPA 80** for fire-rated doors
2. **Blocking**: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as follows:
   a. 5-inch (125-mm) top-rail blocking.
   b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
   c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
   d. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
3. **Edge Construction**: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. **Pairs**: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

## 2.4 LIGHT FRAMES

A. **Metal Frames for Light Openings**: Manufacturer's standard frame formed of 18 gauge, cold-rolled steel sheet, factory primed.
1. **Where fire rated doors are indicated**, metal frames for light openings shall match fire rating indicated for doors.

## 2.5 FABRICATION

A. **Fabricate doors** in sizes indicated for Project-site fitting.
1. Comply with clearance requirements of referenced quality standard for fitting.

B. **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.

## 2.6 FACTORY FINISHING

A. **General**: Comply with AWS "Architectural Woodwork Standards - Edition 1" for factory finishing.

B. **Finish doors at factory**.

C. **Transparent Finish**:
   1. **Grade: Premium**.
   2. **Finish:** AWS System 11/12 "Catalyzed polyurethane".
   3. **Staining:** As listed in the Color Schedule or if not listed then as selected by Architect from manufacturer's full range.
   4. **Effect**: Open-grain finish.
   5. **Sheen**: Semigloss.

# 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 8 Section "Door Hardware."

B. **Manufacturer's Written Instructions**: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

C. **Job-Fitted Doors**: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
   1. **Clearances:** Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.
      a. Comply with **NFPA 80** for fire-rated doors.
   2. **Bevel non-fire-rated doors** 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
   3. **Bevel fire-rated doors** 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

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 refinished if work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION**

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# SECTION 08 3100

# ACCESS DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. **Wall access** doors and **frames**.
2. **Ceiling access** doors and **frames**.
3. **Floor access** doors and **frames**.

B. **Related Sections** include the following:
1. **Division 4** Section "**Unit Masonry Assemblies**" for anchoring and grouting access door frames set in masonry construction.
2. **Division 7** Section "**Roof Accessories**" for roof hatches.
3. **Division 8** Section "**Door Hardware**" for mortise or rim cylinder locks and master keying.
4. **Division 15** Section "**Duct Accessories**" for heating and air-conditioning duct access doors.
5. **Division 15** Section "**Storm Drainage Piping**" for connection of floor door drainage couplings to drains.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

B. **Shop Drawings**: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

C. **Schedule**: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

D. **Coordination Drawings**: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
1. Method of attaching door frames to surrounding construction.
2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

### 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain doors and frames through one source from a single manufacturer.

B. **Size Variations**: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

## 1.5 COORDINATION

A. **Verification**: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

## 1.6 ALLOWANCES

A. **Beyond the access doors** indicated **on the drawings** that are called out with sizes and locations, the Contractor shall include **five (5) 24" x 24" flush panel** access doors and **five (5) 24" x 24" flush one hour fire rated** panel access doors to be located as directed by the **Architect**. Cost to include installation and General Contractor's mark up. The doors may be located in **gypsum board** or **masonry walls**, in order to determine the **cost of the allowance** provide which ever type of door is more expensive. If all of the doors in the allowance are not used, provide a **credit** to the Owner.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. **Access Doors**:
   a. **J. L.** Industries, Inc.
   b. **Larsen's** Manufacturing Company.
   c. **Milcor** Limited Partnership.
   d. **Nystrom** Building Products.

## 2.2 MATERIALS

A. **Steel Plates, Shapes, and Bars**: ASTM A 36/A 36M.

B. **Electrolytic Zinc-Coated Steel Sheet**: ASTM A 591/A 591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.

C. **Drywall Beads**: Edge trim formed from **22 gauge** zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

## 2.3 PAINT

A. **Shop Primer for Ferrous Metal**: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

## 2.4 ACCESS DOORS AND FRAMES

A. **Flush, Insulated, Fire-Rated Access Doors and Trimless Frames**: Fabricated from steel sheet.
   1. **Locations**: **Gypsum board wall** and **ceiling** surfaces. Fire resistance rating to be **1 hour minimum** rating or as scheduled on the drawings.
   2. **Door**: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of **20 gauge**.
   3. **Frame**: Minimum **16 gauge** sheet metal with 1-inch (25 mm) wide, surface-mounted trim.
   4. **Hinges**: Continuous piano hinge.
   5. **Automatic Closer**: Spring type.
   6. **Latch**: Self-latching bolt operated by knurled knob with interior release.
   7. **Lock**: Key-operated cylinder lock with interior release.
   8. **Size**: As indicated on the drawings, or for determining the allowance provide a 24" x 24".

B. **Flush Access Doors and Frames with Exposed Trim**: Fabricated from steel sheet.
   1. **Locations**: **Masonry, concrete** and **ceramic-tile** wall surfaces.
   2. **Door**: Minimum **16 gauge** sheet metal, set flush with exposed face flange of frame.
   3. **Frame**: Minimum **16 gauge** sheet metal with 1-inch (25 mm) wide, surface-mounted trim.
   4. **Hinges**: Continuous piano hinge.
   5. **Latch**: Screwdriver-operated cam latch.
   6. **Lock**: Key-operated cylinder lock.
   7. **Size**: As indicated on the drawings, or for determining the allowance provide a 24" x 24".

C. **Flush Access Doors and Trimless Frames**: Fabricated from steel sheet.
   1. **Locations**: **Gypsum board wall** and **ceiling** surfaces.
   2. **Door**: Minimum **16 gauge** sheet metal, set flush with surrounding finish surfaces.
   3. **Frame**: Minimum **16 gauge** sheet metal with drywall bead.
   4. **Hinges**: Continuous piano hinge.
   5. **Latch**: Screwdriver-operated cam latch.
   6. **Lock**: Key-operated cylinder lock.
   7. **Size**: As indicated on the drawings, or for determining the allowance provide a 24" x 24".

D. **Floor Doors, General**: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
   1. **Aluminum Floor Door**: Extruded-aluminum angle frame with 1/4-inch-(6.4-mm-) thick, diamond-pattern, aluminum tread plate door; nonwatertight; loading capacity to support 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load. Aluminum mill finish.
   2. **Options**: If available from specified manufacturers, include the following options:
      a. **Hinges**: Heavy-duty, zinc-coated steel or stainless-steel butt hinges with stainless-steel pins.
      b. **Latch**: Stainless-steel slam latch.
      c. **Hardware Material**: Manufacturer's standard.

## 2.5 FABRICATION

A. **General**: Provide access door assemblies manufactured as integral units ready for installation.

B. **Metal Surfaces**: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. **Steel Doors and Frames**: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
   1. **Exposed Flanges**: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
   2. **For trimless frames** with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
   3. **Provide mounting holes** in frames to attach frames to framing in drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.

D. **Latching Mechanisms**: Furnish number required to hold doors in flush, smooth plane when closed.
   1. **For cylinder lock**, furnish **two keys per lock** and key all locks alike.

## 2.6 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.

## 2.7 METALLIC-COATED STEEL FINISHES

A. **Galvanizing of Steel Shapes and Plates**: Hot-dip galvanize items indicated to comply with applicable standard listed below:
   1. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. **Surface Preparation**: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
   1. **Galvanizing Repair Paint**: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. **Factory Priming for Field-Painted Finish**: Apply shop primer immediately after cleaning and pretreating.

## 2.8 STEEL FINISHES

A. **Surface Preparation**: 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): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. **Interiors** (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

B. **Apply shop primer** to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. **Advise installers** of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

## 3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames and floor doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install access doors with trimless frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material.

## 3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

**END OF SECTION**

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# SECTION 08 4100

# ALUMINUM ENTRANCES AND STOREFRONTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following types of aluminum entrance and storefront work:
1. **Exterior entrance** doors.
2. **Interior** doors and windows.
3. **Sidelights**.
4. **Frames** for entrances.

B. **Related Sections**: The following sections contain requirements that relate to this Section:
1. **Division 7** Section "**Air, Water, and Vapor Barriers**" for building air barrier system.
2. **Division 7** Section "**Joint Sealants**" for sealing between storefront system and the substrate.
3. **Division 8** Section "**Glazing**" for requirements for aluminum entrances and storefront, including entrances specified to be factory glazed.
4. **Division 8** Section "**Door Hardware**" for hardware related to aluminum doors. **Installation** of furnished hardware shall be **by Aluminum Contractor**.

### 1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. **General**: Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified, as demonstrated by testing the manufacturer's corresponding stock assemblies according to test methods indicated.

B. **Thermal Movement**: Design the aluminum entrance and storefront framing systems to provide for expansion and contraction of the component materials. Entrance doors shall function normally over the specified temperature range.
1. **The system shall be capable of withstanding** a metal surface temperature range of 180 deg F (100 deg C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

C. **Design Requirements**: Provide aluminum entrance and storefront systems that comply with structural performance, air infiltration, and water penetration requirements indicated.
1. **Wind Loads**: Provide aluminum entrance and storefront assemblies capable of withstanding wind pressures of 20 psf inward and 20 psf outward acting normal to the plane of the wall.

D. **Structural Performance**: Conduct tests for structural performance in accordance with ASTM E 330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2 percent of their clear span.

1. **Deflection Normal to the Plane of the Wall**: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/175 of the clear span, when subjected to uniform load deflection test.
2. **Deflection Parallel to the Plane of the Wall**: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/8 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.

E. **Air Infiltration**: Provide aluminum entrance and storefront framing system with an air infiltration rate of not more than 0.06 CFM per sq. ft. of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.

F. **Water Penetration**: Provide framing systems with no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 6.24 lbf per sq. ft.

G. **Condensation Resistance**: Where framing systems are "thermal-break" construction, provide units tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

## 1.4 SUBMITTALS

A. **General:** Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

1. **Product Data:** Product data for each aluminum entrance and storefront system required, including:
   a. **Manufacturer's standard details** and fabrication methods.
   b. **Manufacturer's standard installation details** for each system
   c. **Data on finishing**, hardware and accessories.
   d. **Recommendations for maintenance** and cleaning of exterior surfaces.
2. **Shop Drawings**: Shop drawings for each aluminum entrance and storefront system required, including:
   a. **Layout and installation details**, including relationship to adjacent work.
   b. **Elevations** at 1/4-inch scale.
   c. **Detail sections** of typical composite members.
   d. **Anchors** and reinforcement.
   e. **Hardware mounting** heights.
   f. **Provisions for expansion** and contraction.
   g. **Glazing** details.
3. **Samples for Color Selection:** Submit pairs of samples of each specified color and finish on 12-inch-long sections of extrusions or formed shapes. Where normal color variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of color variations.

4. **Test Reports**: Provide certified test reports from a qualified independent testing laboratory showing that aluminum entrance and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: Engage an experienced Installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.

B. **Manufacturer's Qualifications**: Provide aluminum entrances and storefront systems produced by a firm experienced in manufacturing systems that are similar to those indicated for this project and that have a record of successful in-service performance.

C. **Single Source Responsibility**: Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.

D. **Design Criteria**: The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required and are based on the specific types and models indicated. Aluminum entrance and storefront by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

E. **Certificate of assembled U-factor:** The **installer** or **supplier** on the fenestration system (which includes the **glazing** as well as the **aluminum** system) shall provide a **signed** and **dated certificate** for the installed fenestration system listing the assembly **U-factor**, the **solar heat gain coefficient** and the **air leakage rate**. This is to meet the exception to the Labeling of Fenestration Products under **Item 5.8.2.2** of the ANSI/ASHRA/IESNA STANDARD **90.1-2007 and the requirements of IECC**. Energy performance of fenestration must be determined based on criteria of NFRC 100 and 200. For LEED submissions or where windows and doors are to be site-built, furnish certificate of overall product performance generated using NFRC Component Modeling Approach software tool (CMAST).
   1. Fenestration systems shall have a **maximum assembly U value of 0.33** and a **maximum SHGC of 0.34**.
   2. Certifications reflecting only the center of glass values are not acceptable.
   3. Once all site-built components have been installed, but prior to final inspection, the **Contractor shall retain an ACE** (Approved Calculation Entity) **to generate the NFRC label certificate** for the project based on the actual products installed.
   4. All costs associated with certification of fenestration systems shall be borne by the contractor.

## 1.6 PRE-INSTALLATION CONFERENCE

A. **Pre-installation conference** shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Architect, Contractor, installer, and manufacturers representatives. Notify participants at least ten (10) working days before conference.

B. **A separate pre-installation conference** shall be conducted prior to the installation of electronic security hardware with the electrical contractor to review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** aluminum entrance and storefront components in the manufacturer's original protective packaging.

B. **Store** aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.
   1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

## 1.8 PROJECT CONDITIONS

A. **Field Measurements:** Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work
   1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

## 1.9 WARRANTY

A. **Special Assembly 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 deteriorate as defined in this Section within specified warranty period.
   1. **Failures include**, but are not limited to, the following.
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water leakage through fixed glazing and framing areas.
      e. Failure of operating components to function properly.
      f. **Warranty Period**: **5 years** from date of Substantial Completion.
   2. **Special Finish Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
      a. **Warranty Period: 5 years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish as standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Kawneer North America; an Alcoa Company.
   2. **Storefront**: TriFab VG 451T (exterior), 450 (interior).
   3. **Operable:** GLASSvent for Storefront.
   4. **Entrances**: Tuffline 500

B. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering entrance and storefront systems that may be incorporated in the work include the following:
   1. **Kawneer** North America.
   2. **Tubelite,** division of Indal, Inc.
   3. C.R. Lawrence/**United States** Aluminum Corp.
   4. **EFCO** Corporation.
   5. **Oldcastle** BuildingEnvelope.

### 2.2 MATERIALS

A. **Aluminum Members**: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.

B. **Carbon Steel**: Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

C. **Glass and Glazing Materials**: Comply with requirements of "Glass and Glazing" section of these specifications.

D. **Fasteners**: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.
   1. **Reinforcement:** Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.
   2. **Exposed Fasteners**: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

E. **Concealed Flashing**: 0.0179-inch (26 gage) minimum dead-soft stainless steel, or 0.026-inch-thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

F. **Brackets and Reinforcements**: Provide high-strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

G. **Concrete and Masonry Inserts**: Provide cast iron, malleable iron, or hot-dip galvanized steel inserts complying with ASTM A 123.

H. **Compression Weatherstripping**: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

## 2.3 ALUMINUM STOREFRONT HARDWARE SCHEDULE

A. **Refer to Division 8** Section "**Door Hardware**" for all items of hardware other than those indicated to be provided by the aluminum storefront entrance supplier.

## 2.4 COMPONENTS

A. **Storefront Framing System**: Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Include subframes and other reinforcing members of the type indicated. Provide for storefront glazed from the exterior on all sides with projecting stops as scheduled. Shop-fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.

1. **Mullion Configurations**: Provide pockets at the inside glazing face to receive resilient elastomeric glazing. Mullions and horizontals shall be one piece. Make provisions to drain moisture accumulation to the exterior.

B. **Entrance Door Frames**: Provide tubular and channel frame entrance door frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards. Reinforce as necessary to support required loads. Entrance doors and frames shall be supplied as a complete system. Frames shall be **minimum 3/16"** wall thickness.

C. **Stile-and-Rail Type Entrance Doors**: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.

1. **Glazing**: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for nonremoval.
2. **Design**: Provide **2-inch-thick doors** with **minimum 3/16 inch wall thickness**.
   a. Mount all **pulls** with **thru bolts** using sex bolts.

D. **Operable projected windows in storefront system**: Provide projected windows as indicated on the drawings.

## 2.5 FABRICATION

A. **General**: Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings. Variable dimensions are indicated, with maximum and minimum dimensions required, to achieve design requirements and coordination with other work.

1. **Thermal-Break Construction**: Fabricate exterior storefront framing system with an integrally concealed, low-conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.

B. **Prefabrication**: Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the Project site. Disassemble components only as necessary for shipment and installation.
1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.
2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

C. **Welding**: Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish.
1. Welding behind finished surfaces shall be performed in such a manner as to minimize distortion and discoloration on the finished surface.

D. **Reinforcing**: Install reinforcing as required for hardware and as necessary for performance requirements, sag resistance and rigidity.

E. **Dissimilar Metals:** Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.

F. **Continuity**: Maintain accurate relation of planes and angles with hairline fit of contacting members.

G. **Fasteners**: Conceal fasteners wherever possible.

H. **Weather stripping:** For exterior doors, provide compression weather stripping against fixed stops. At other edges, provide sliding weather stripping retained in adjustable strip mortised into door edge.
1. **Provide EPDM or vinyl-blade gasket weather stripping** in bottom door rail, adjustable for contact with threshold.
2. **At interior doors** and other locations without weather stripping, provide **neoprene silencers** on stops to prevent metal-to-metal contact.

## 2.6 FINISHES

A. **General**: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. **Appearance of Finished Work**: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. **AA Designations:** Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. **Clear Anodic Finish** - AA-M12C22A41 **Mechanical Finish**: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural **Class I clear coating 0.7 mils or thicker**, complying with AAMA 607.1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates and supports**, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts. Correct unsatisfactory conditions before proceeding with the installation.
   1. **Do not proceed with installation** until unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

A. **Comply with manufacturer's instructions** and recommendations for installation.

B. **General**: Set units plumb, level, square, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines and grades indicated. Provide proper support and anchor securely in place.

C. **Construction Tolerances**: Install aluminum entrance and storefront to comply with the following tolerances:
   1. **Variation from Plane**: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
   2. **Offset from Alignment**: The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.
   3. **Diagonal Measurements**: The maximum difference in diagonal measurements shall not exceed 1/8 inch.
   4. **Offset at Corners**: The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

D. **Separate aluminum and other corrodible metal surfaces** from sources of corrosion or electrolytic action at points of contact with other materials.
   1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.
   2. Paint dissimilar metals where drainage from them passes over aluminum.
   3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.
   4. Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or otherwise subject to wetting, with two coats of aluminum house paint. Seal joints between the materials with sealant.

E. **Drill and tap frames and doors** and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
   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.

F. **Set sill members** and other members in properly engineered sealant joints, or with joint fillers or gaskets as indicated to provide weather tight construction. Comply with requirements of **Division 7** for **sealants**, fillers, and gaskets.

G. Refer to "**Glass and Glazing**" Section of **Division 8** for installation of glass and other panels indicated to be glazed into doors and framing, and not preglazed by manufacturer.

## 3.3 FIELD QUALITY CONTROL

A. Test aluminum systems in accordance with Division 1 Sections "Building Enclousre Commissioning Requirements" and "Building Enclosure Functional Testing Requirements".

## 3.4 ADJUSTING

A. **Adjust operating hardware** to function properly, for smooth operation without binding, and for weathertight closure.

## 3.5 CLEANING

A. **Clean the completed system**, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. **Clean glass surfaces after installation**, complying with requirements contained in the "Glass and Glazing" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

## 3.6 PROTECTION

A. **Institute protective measures** required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

## 3.7 ALUMINUM DOOR HARDWARE

A. Refer to **Division 8** Section "**Door Hardware**" for hardware related to aluminum doors and storefronts.

B. Hardware shall be installed by the aluminum door contractor, regardless of its origin.

**END OF SECTION**

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# SECTION 08 4329

# SLIDING AUTOMATIC ENTRANCE DOORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Single-sliding, automatic entrance door assemblies.

B. **Related Sections** include the following:
   1. **Division 8** Section "**Aluminum-Framed Entrances and Storefronts**" for entrances controlled by automatic door operators furnished separately in Division 8 Sections.
   2. **Division 8** Section "**Door Hardware**" for hardware to the extent not specified in this Section.
   3. **Division 8** Section "**Glazing**" for materials and installation requirements of glazing for automatic entrance doors.
   4. **Division 26** Sections for electrical connections including conduit and wiring for automatic entrance door operators.

### 1.3 DEFINITIONS

A. **Activation Device**: Device that, when actuated, sends an electrical signal to the door operator to open the door.

B. **Safety Device**: Device that prevents a door from opening or closing.

### 1.4 PERFORMANCE REQUIREMENTS

A. **General**: Provide automatic entrance door assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

B. **Structural Loads**:
   1. Wind Loads: As indicated on Drawings.
   2. Seismic Loads: As indicated on Drawings.

C. **Thermal Movements**: Provide automatic entrance doors 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 joint sealants, 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. **Operating Range**: Minus 20 deg F (29 deg C) to 130 deg F (54 deg C).

E. **Air Infiltration**: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. (6.4 L/s x sq. m) of fixed entrance system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

F. **Opening-Force Requirements**:
1. Egress Doors: Not more than 50 lbf (222 N) required to manually set door in motion if power fails, and not more than 15 lbf (67 N) required to open door to minimum required width.
2. Accessible Interior Doors: Not more than 5 lbf (22.2 N).

G. **Closing-Force Requirements**: Not more than 30 lbf (133 N) required to prevent door from closing.

## 1.5 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrance doors.

B. **Shop Drawings**: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Wiring Diagrams: Power, signal, and control wiring.

C. **Samples for Selection**: For units with factory-applied color finishes.

D. **Product Certificates**: For each type of emergency-exit automatic entrance door, signed by product manufacturer.

E. **Qualification Data**: For Installer.

F. Field quality-control test and inspection reports.

G. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for automatic entrance door assemblies.

H. **Maintenance Data**: For door operators and control systems to include in maintenance manuals.

I. **Warranties**: Special warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. **Manufacturer Qualifications**: A qualified manufacturer with company certificate issued by AAADM.

C. **Certified Inspector**: Certified by AAADM.

D. **Source Limitations**: Obtain automatic entrance door assemblies through one source from a single manufacturer.

E. **Product Options**: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

F. **Welding**: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

G. **Power-Operated Door Standard**: BHMA A156.10.

H. **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.

I. **Emergency-Exit Door Requirements**: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

J. **Preinstallation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.7 PROJECT CONDITIONS

A. **Field Measurements**: Verify openings to receive automatic entrance door assemblies 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 automatic entrance door assemblies without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.8 COORDINATION

A. Coordinate size and location of recesses in concrete floors for recessed sliding tracks. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. **Templates**: Obtain and distribute, to the parties involved, templates for doors, frames, and other work specified to be factory prepared for installing automatic entrance doors. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrance doors to comply with indicated requirements.

C. **Electrical System Roughing-in**: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies.

## 1.9 WARRANTY

A. **Special Assembly Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrance door assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Faulty operation of operators, controls, and hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. **Warranty Period**: Three 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 fail within specified warranty period. Warranty does not include normal weathering.
   1. **Warranty Period**: 20 years from date of Substantial Completion.

## 1.10 MAINTENANCE SERVICE

A. **Initial Maintenance Service**: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of automatic entrance door assembly Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance door assembly operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   1. Engage a certified inspector to perform safety inspection after each adjustment or repair, and at end of maintenance period. Submit completed inspection form to Owner.
   2. Perform maintenance, including emergency callback service, during normal working hours.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Single-Sliding Units**:
      a. Besam Automated Entrance Systems, Inc.
      b. DORMA Automatics; Div. of DORMA Group North America.
      c. Horton Automatics; Div. of Overhead Door Corporation.
      d. Stanley Access Technologies; Div. of The Stanley Works.

## 2.2 MATERIALS

A. **Aluminum**: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   2. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   3. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. **Sealants and Joint Fillers**: Refer to Division 7 Section "Joint Sealants."

C. **Nonmetallic, Shrinkage-Resistant Grout**: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.

D. **Bituminous Paint**: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil (0.76-mm) thickness per coat.

## 2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. **General**: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

B. **Sliding Automatic Entrance Door**:
1. **Configuration**: Single-sliding door, with one sliding leaf and sidelite.
   a. Traffic Pattern: Two way.
   b. Emergency Breakaway Capability: Sliding leaf only.
   c. Mounting: Surface.
2. **Activation Device**: Motion detector mounted on each side of door header to detect pedestrians in activating zone and to open door.
3. **Safety Devices**: Two photoelectric beams mounted in sidelite jambs to detect pedestrians in presence zone and to prevent door from closing.
4. **Finish**: Finish framing, door(s), sidelite(s), and header with Class I, clear anodic finish.

## 2.4 COMPONENTS

A. **Framing Members**: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.
1. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch (1.6-mm) wall thickness.

B. **Stile and Rail Doors**: Manufacturer's standard 1-3/4-inch- (45-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
2. Stile Design: Wide stile; 6-inch (152-mm) nominal width.
3. Rail Design: 10-inch (254-mm) nominal height.

C. **Sidelites**: Manufacturer's standard 1-3/4-inch- (45-mm-) deep sidelites with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular stile and rail members matching door design.
1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.

D. **Glazing**: As specified in Division 8 Section "Glazing."

E. **Headers**: Fabricated from minimum 0.125-inch- (3.2-mm-) thick extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
   1. Mounting: Surface mounted.
   2. Capacity: Capable of supporting doors up to 175 lb (79 kg) per leaf over spans up to 14 feet (4.3 m) without intermediate supports.
      a. Provide sag rods for spans exceeding 14 feet (4.3 m).

F. **Carrier Assemblies and Overhead Roller Tracks**: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
   1. Rollers: Minimum two ball-bearing roller wheels and two antirise rollers for each active leaf.

G. **Threshold**: Manufacturer's standard threshold members and bottom-guide track system, with stainless-steel ball-bearing-center roller wheels.
   1. Configuration: Saddle-type threshold across door opening and inverted, roller-guide track system at sidelites.

H. **Brackets and Reinforcements**: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

I. **Fasteners and Accessories**: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

J. **Caution Sign**: BHMA A156.10; 6 inches (150 mm) in diameter, with minimum 1/2-inch- (13-mm-) high, black lettering on a yellow background with the words "CAUTION AUTOMATIC DOOR."

K. **Emergency Breakaway Sign**: BHMA A156.10; red background with 1-inch- (25-mm-) high contrasting letters with the words "IN EMERGENCY PUSH TO OPEN."

## 2.5 DOOR OPERATORS

A. **General**: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
   1. **Door Operator Performance**: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind pressures.

B. **Electromechanical Operators**: Self-contained overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation including spring closing with power off.
   1. Operation: Power opening and spring closing.
   2. Features:
      a. Adjustable opening and closing speeds.
      b. Adjustable backcheck and latching.

c. Adjustable hold-open time between 0 and 30 seconds.
d. Obstruction recycle.
e. On-off/hold-open switch to control electric power to operator.
f. Energy conservation switch that reduces door-opening width.

3. Mounting: Surface.

## 2.6 ACTIVATION AND SAFETY DEVICES

A. **Motion Detectors**: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds.

1. Provide capability for switching between bi-directional and uni-directional detection.

B. **Photoelectric Beams**: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

C. **Electrical Interlocks**: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

D. **Opening-Width Control Switch**: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

## 2.7 HARDWARE

A. **General**: Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish, unless otherwise indicated.

B. **Emergency Breakaway Hardware**: Provide release hardware that allows panel to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf (222 N) according to BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.

C. **Deadlocks**: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn; with minimum 1-inch- (25-mm-) long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: As specified in Division 8 Section "Door Hardware."
   a. Keying: Integrate into building master key system.
2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
3. Two-Point Locking: Mechanism in stile of active door leaf that automatically extends lockbolt into overhead carrier assembly.

D. **Sliding Weather Stripping**: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

E. **Weather Sweeps**: Manufacturer's standard nylon brush sweep mounted to underside of door bottom.

## 2.8 FABRICATION

A. **General**: Factory fabricate automatic entrance door assembly components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
   1. Form aluminum shapes before finishing.
   2. 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.
   3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
      a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
      b. Reinforce members as required to receive fastener threads.
   4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. **Framing**: Provide automatic entrance doors as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
   1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
   2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
   3. Form profiles that are sharp, straight, and free of defects or deformations.
   4. Prepare components to receive concealed fasteners and anchor and connection devices.
   5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
   6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
   7. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
   8. Allow for thermal expansion of exterior units.

C. **Doors**: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. **Door Operators**: Factory fabricated and installed in headers, including adjusting and testing.

E. **Glazing**: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. **Hardware**: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
   1. Provide sliding weather stripping, mortised into door, at perimeter of sliding doors.

G. **Activation and Safety Devices**: Factory install devices in doors and headers.
   1. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
      a. Top Beam: 48 inches (1219 mm).
      b. Bottom Beam: 24 inches (610 mm).

## 2.9 ALUMINUM FINISHES

A. **General**: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. **Class I, Clear Anodic Finish**: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrance doors.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. **General**: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

B. **Entrances**: Install automatic entrance doors plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
   1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
   2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
   3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
   4. Level recesses for recessed thresholds using nonshrink grout.

C. **Door Operators**: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. **Activation and Safety Devices**: Adjust devices to provide detection field and functions indicated.

E. **Glazing**: Install glazing as specified in Division 8 Section "Glazing."

F. **Sealants**: Comply with requirements specified in Division 7 Section "Joint Sealants" to provide weather tight installation.
   1. Set framing members, thresholds, bottom-guide track system, and flashings in full sealant bed.
   2. Seal perimeter of framing members with sealant.

G. **Signage**: Provide caution signs on each automatic entrance door, visible from both sides of door. Mount caution signs with centerline 58 inches (1475 mm) above finished floor.
   1. Emergency Breakaway Panels: Provide emergency breakaway sign visible to egress side of each automatic entrance door that has emergency breakaway capability. Mount signs adjacent to lock stile with centerline between 36 and 60 inches (900 and 1525 mm) above finished floor.

## 3.3 FIELD QUALITY CONTROL

A. **Inspector**: Engage Installer's certified inspector to test and inspect automatic entrance doors and prepare test and inspection reports.

B. **Testing Services**: Certified inspector shall test and inspect each automatic entrance door to determine compliance of installed systems with applicable BHMA standards.
   1. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation, for weather tight closure, and complying with requirements in BHMA A156.10.

B. Lubricate operating hardware and other moving parts.

C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

D. **Occupancy Adjustment**: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

## 3.5 CLEANING AND PROTECTION

A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
   1. Comply with requirements in Division 8 Section "Glazing" for cleaning and maintaining glass.

## 3.6 DEMONSTRATION

A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrance doors and door operators. Refer to Division 1 Section "Closeout Procedures."

**END OF SECTION**

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# SECTION 08 4416

# GLAZED ALUMINUM CURTAIN WALLS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Conventionally and silicone-structural glazed aluminum curtain wall** installed as stick system.

B. **Sunshades and shading louvers** attached to curtainwall mullions.
1. All exterior sun shades furnished and installed as shown on Drawings and specified in this section.
2. All labor, materials, tools, equipment and services needed to furnish and install sun shades supported by, and integral with, windows, curtainwall and/or window wall.
3. Sunshades shall be designed, finished, and manufactured by the curtainwall manufacturer.
4. Components furnished with installed sun shades.
5. Installation accessories furnished and installed.

C. **Miscellaneous brake metal trims**.

D. **Related Sections** include the following:
1. **Division 1** Section "**Mock-up Requirements**" for coordination of curtainwall components into large scale, testable mock-up of exterior wall systems.
2. **Division 7** Section "**Air, Water, and Vapor Barriers**" for building air barrier system.
3. **Division 7** Section "**Fire-Resistive Joint Systems**" for perimeter fire-containment systems (safing insulation) field installed with glazed aluminum curtain-wall systems.
4. **Division 7** Section "**Joint Sealants**" for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
5. **Division 8** Section "**Aluminum Entrances and Storefronts**" for entrance and storefront systems installed adjacent to or within glazed aluminum curtain-wall systems.
6. **Division 8** Section "**Glazing**" for insulating-glass requirements.

### 1.3 PERFORMANCE REQUIREMENTS

A. **General:** Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferred 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 thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant failure.

B. **Structural Loads:**
1. **Wind Loads**: Provide aluminum entrance and storefront assemblies capable of withstanding wind pressures of 20 psf inward and 20 psf outward acting normal to the plane of the wall but in any case no less than loads indicated on Drawings.
2. **Seismic Loads**: As indicated on Drawings.
3. **Periodic Maintenance-Equipment Loads**: As indicated on Drawings.

C. **Structural-Test Performance:** Provide glazed aluminum curtain-wall systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. 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.
3. Test Duration: As required by design wind velocity but not less than 60 seconds.

D. **Deflection of Framing Members:**
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m), and to 1/240 of clear span plus 1/4 inch (6.35 mm), for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
   a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

E. **Story Drift**: Provide glazed aluminum curtain-wall systems that accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
2. Test Performance: No glass breakage, anchor failures, or structural damage when tested according to AAMA 501.4.

F. **Thermal Movements:** Provide glazed aluminum curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
   2. Test Performance: No buckling, stress on glass, glazing-edge seal failure, sealant failure, excess stress on curtain-wall framing, anchors and fasteners, or reduction of performance when tested according to AAMA 501.5.
      a. Test High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of 180 deg F (82 deg C.
      b. Test Low Exterior Ambient Air Temperature: 0 deg F (minus 18 deg C).
      c. Test Interior Ambient Air Temperature: 75 deg F (24 deg C).

G. **Air Infiltration:** Provide glazed aluminum curtain-wall systems with maximum air leakage of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

H. **Water Penetration under Static Pressure:** Provide aluminum glazed curtain-wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

I. **Condensation Resistance:** Provide glazed aluminum curtain-wall systems with condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.

J. Sloped Glazing: System fabrication shall provide proper drainage of sill pieces and other horizontal members, despite slope of wall. Ponding of water at sill will not be tolerated.

## 1.4 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. **Shop Drawings:** Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain-wall systems.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Shop drawings shall include design and attachment of sun shades and sun screens as shown on Drawings and specified herein, whether or not such items are furnished by aluminum manufacturer.
   3. Delegated Design/Deferred submittal: To be submitted to the Building Code Official for structural peer review.
   4. Shop drawings for curtainwall system shall include, but are not limited to:
      a. Layout and installation details, including relationship to adjacent work.
      b. Elevations at 1/4-inch scale.
      c. Detail sections of typical composite members.
      d. Anchors and reinforcement.
      e. Hardware mounting heights.
      f. Provisions for expansion and contraction.
      g. Glazing details.
      h. Sunshade mounting and details.

5. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. **Fabrication Sample:** Of each vertical-to-horizontal intersection of systems, made from 24-inch lengths of full-size components and showing details of the following:
1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.
6. 24 inch square section of horizontal sun louver system, showing end condition, bracket for connection back to curtainwall and louver connections to end frame.

D. **Welding certificates.**

E. **Qualification Data:** For Installer.

F. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for glazed aluminum curtain-wall systems.

G. **Warranties**: Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.
1. Engineering Responsibility: Preparation of data for glazed aluminum curtain-wall systems including the following:
   a. Shop Drawings, Project-specific preconstruction-testing program development, and comprehensive engineering analysis by a qualified professional engineer. Analysis shall include sun control devices and other appurtenances.

B. **Product Options:** Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. **Welding:** Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

D. **Certificate of assembled U-factor and solar heat gain coefficient (SHGC):** The **installer** or **supplier** on the fenestration system (which includes the **glazing (including spacer)** as well as the **aluminum** system) shall provide a **signed** and **dated certificate** for the installed fenestration system listing the assembly **U-factor**, the **solar heat gain coefficient** and the **air leakage rate**. This is to meet the exception to the Labeling of Fenestration Products under **Item 5.8.2.2** of the ANSI/ASHRA/IESNA STANDARD **90.1-2007 and the requirements of IECC**. Energy performance of fenestration must be determined based on criteria of NFRC 100 and 200. For LEED submissions or where windows and doors are to be site-built, furnish certificate of overall product performance generated using NFRC Component Modeling Approach software tool (CMAST).

1. Fenestration systems shall have a **maximum assembly U value of 0.33** and a **maximum SHGC of 0.34**.
2. Certifications reflecting only the center of glass values are not acceptable.
3. Once all site-built components have been installed, but prior to final inspection, the **Contractor shall retain an ACE** (Approved Calculation Entity) **to generate the NFRC label certificate** for the project based on the actual products installed.
4. All costs associated with certification of fenestration systems shall be borne by the contractor.

E. **Mockups:** Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. **Mock-up: Building Envelope**
   a. As shown on Drawings, incorporate components of curtain wall system in exterior envelope mock-up. Curtain wall shall be subject to testing with wall system. Incorporation in the free-standing mock-up does not relieve the Contractor of demonstrating that curtain wall meets all performance criteria outlined herein.
   b. All curtainwall work in envelope mock-up shall be performed by comparably skilled and experienced workers to those who will actually be performing the work for the Project
   c. Install curtainwall system in accordance with design documents and manufacturer's installation instructions. Curtainwall installation shall be complete, including clips, sill and head pieces, trims,flashing, shims, and glazing. Curtainwall work shall be as proposed for actual construction of building.
   d. Curtainwall system (or individual components thereof) shall be removed and replaced with new if visual observation or testing demonstrates failure to conform to testing requirements or design intent.
   e. Approved mockup shall be retained intact and without damage throughout the construction process. Remove and dispose of properly off Owner's property and in accordance with the Waste Management Plan at Substantial Completion or when so directed by Architect.

F. **Pre-installation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to glazed aluminum curtain-wall systems including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspecting, and certifying procedures.

## 1.6 PROJECT CONDITIONS

A. **Field Measurements:** Verify actual locations of structural supports for glazed aluminum curtain-wall 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 glazed aluminum curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.7 WARRANTY

A. **Special Assembly Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water leakage.
      e. Failure of operating components to function normally.
   2. **Warranty Period: 5 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 fail within specified warranty period. Warranty does not include normal weathering.
   1. **Warranty Period: 5 years** from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Kawneer North America.
      a. **Conventional Curtain Wall System:** 1600 Wall System 3, outside glazed, pressure plate and structural silicone glazed (SSG) format.
      b. **Operable Units:** GLASSvent for curtainwall.
      c. **Vertical, Fixed Sunshades**: Kawneer Versoleil.
   2. **Manufacturer:** American Warming and Ventilating
      a. **Sun Screen**: SCL-8AF

B. **Acceptable Manufacturers**: Subject to compliance with requirements, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
   1. **Kawneer NA**; www.kawneer.com.
   2. **C.R. Laurence/United States Aluminum**; www.usalum.com
   3. **Oldcastle BuildingEnvelope** (Vistawall); www.oldcastlebe.com
   4. **EFCO** Corporation; www.efcocorp.com

5. **Tubelite** Division of Indal, Inc.; www.tubeliteinc.com
6. **Wausau** Window and Wall Systems; www.wausauwindow.com
7. **American Warming and Ventilating** (sun screen only); www.amv.com

## 2.2 FRAMING SYSTEMS

A. **Aluminum:** Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. **Steel Reinforcement:** With manufacturer's standard 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 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. **Brackets and Reinforcements:** Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. **Fasteners and Accessories:** Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. **Anchors**: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. **Concealed Flashing:** Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. **Framing Gaskets:** As recommended by manufacturer for joint type.

H. **Snap-on Face Caps:** Provide face caps (covers) in depths as shown on Drawings; mechanically attached as required by manufacturer.

I. **Thermal Barrier:** Verticals: Rigid polymer that provides a mechanical and chemical bond between the thermal break material and extrusion. Horizontals: Silicone compatible elastomer thermal break separator which will adhere to silicone sealant.

J. **Structural Glazing Adhesive:** Silicone, neutral cure; formulated specifically for structural sealant glazing and complying with ASTM C 1184.
   1. Ultraviolet radiation resistant for 2000 to 4000 micro-watts minimum for 21 days.
   2. Adhesion when subjected to ultraviolet radiation through glass in accordance with ASTM C 794 without failure.
   3. Minimum adhesion tensile strength of 100 psi (690 kPa).
   4. Tested for compatibility with glazing accessories and weatherseal sealant.
   5. Colors as selected by Architect from manufacturer's full range.

K. **Framing Sealants:** As recommended by manufacturer for joint type and as specified in Division 7 Section "Joint Sealants."

## 2.3 FIXED, EXTRUDED- ALUMINUM SUNSHADES

A. **Vertical Fixed, Extruded-Aluminum Sunshade:**
   1. **Louver Depth and Spacing:** 14 inches deep blade, set vertically; spacing as shown on Drawings.
   2. **Blade Angle:** 0 degrees (blades shall be parallel to vertical mullions).
   3. **Materials**
      a. Aluminum Extrusions: Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070” wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 and 6105-T5 alloy and temper.
      b. Aluminum sheet alloy: Shall meet the requirements of ASTM B209.
      c. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
      d. Sealant: For sealants required within fabricated sunshade system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
      e. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.
   4. **Blade Nominal Thickness:** As required to comply with structural performance requirements, but not less than minimum wall thickness of .063" to .125".
   5. **Support Brackets Nominal Thickness:** Sunshade "arms" and mullion clips shall be extrusions with a nominal wall thickness of 0.25".
   6. **Horizontal Components** (blades) shall be mechanically fastened by means of extruded aluminum screw splines.

B. **Structural Perfomance:** Provide sunshades capable of withstanding the effects of gravity loads and the following loads asn stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatique caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.
   1. **Wind Loads:** Determine loads based on a uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward.
   2. **Structural Loads:**
      a. Snow Loads: Not less than 40 pounds per square foot.
   3. **Deflection Limits:** Design framing systems to withstand design loads without deflections greater than the following:
      a. Sunshade Frame and Louvers: Vertical deflection of 1/480 of the span.

## 2.4 SUN SCREENS

A. **Shop fabricated, shop finished, extruded aluminum louvers and fascia,** free of defects impairing strength, durability or appearance. Provide complete with frame and outriggers.

B. **Contractor shall design and provide** all connnections to curtainwall system.

C. **Configuration:** As indicated on Drawings and as follows:
   1. Blade spacing: 8-1/2 inches.
   2. Louver depth: 6 inches.

D. **Louver Type:** Airfoil, solid, 8 inches.

E. **Louver Placement:** Parallel to building facade.

F. **Sun Screen Blade Angle**: 0 degrees from horizontal (blades shall be parallel to horizontal mullions in curtainwall system).

G. **Design Criteria:** Design and fabricate to resist the same loads as curtain wall system as well as the following loads without failure, damage, or permanent deflection:
   1. **Snow: 40 psf;** minimum.
   2. **Thermal Movement:** Plus/minus 1/8 inch (3.175 mm), maximum.

H. **Sizes:** As indicated on Drawings.

I. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

## 2.5 GLAZING SYSTEMS

A. **Glazing**: As specified in Division 8 Section "Glazing."

B. **Glazing Gaskets:** Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. **Glazing Sealants**: As recommended by manufacturer for joint type.
   1. **Sealant Colors:** As selected by Architect.

## 2.6 ACCESSORY MATERIALS

A. **Perimeter Fire-Containment Systems (Safing Insulation)**: Specified in Division 7 Section "Fire-Resistive Joint Systems."

B. **Bituminous Paint**: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

C. **Anodized Aluminum Brake Metal:**
   1. At curtainwall system sill, provide anodized "L- shaped" aluminum trim
      a. Class 1 anodized finish.
         1) Match color of curtain wall system.
      b. Metal thickness: 0.125 inches.
      c. Minimum dimensions: Height of frame and shims (vertical) x 4 inches

(horizontal).
d. Hem or otherwise neatly trim exposed edges.
e. Attach to curtainwall frame with clear silicone sealant; no gap between curtainwall frame and trim piece; trim shall fit tight to floor system.

2. **Where gypsum board and frame walls intersect curtainwall system**, provide anodized aluminum trim piece.
   a. Class 1 anodized finish
      1) Match color of curtain wall system.
   b. Metal gage: 14 ga. (0.063 inches).
   c. Minimum return: 1 inch.
   d. Hem or otherwise neatly trim exposed edges.
   e. Attach to wall system with clear silicone sealant, no gaps along visible edges.

## 2.7 FABRICATION

A. **Form** aluminum shapes **before finishing**.

B. **Fabricate components** that, when assembled, have the following characteristics:
1. Sharp profiles, straight and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring 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 prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
6. Provisions for reglazing from exterior.

C. **Weld in concealed locations** to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. **Factory-Assembled Frame Units:**
1. Rigidly secure nonmovement joints.
2. Seal joints watertight, unless otherwise indicated.
3. Pressure equalize system at its interior face.
4. Install glazing to comply with requirements in Division 8 Section "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

A. **General**: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Standard:** Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. **Clear Anodic Finish** - AA-M12C22A41 Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I clear coating 0.7 mils or thicker complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine areas,** with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. 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 non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   7. 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 by applying sealant or tape or 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. Install components level, square, plumb and true in alignment with established lines and grades.

E. Install glazing as specified Division 8 Section "Glazing."

F. Install sealants as specified in Division 7 Section "Joint Sealants."

G. Install perimeter fire-containment systems (safing insulation) as specified in Division 7 Section "Fire-Resistive Joint Systems."

H. **Erection Tolerances**: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
   2. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (13 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (13 to 25 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

c. Where surfaces are separated by reveal or protruding element of 1 inch (25 mm) wide or greater, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

## 3.3 FIELD QUALITY CONTROL

A. Test aluminum systems in accordance with Division 1 Sections "Building Enclousre Commissioning Requirements" and "Building Enclosure Functional Testing Requirements".

## 3.4 CLEANING

A. **Clean the completed system**, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. **Clean glass surfaces after installation**, complying with requirements contained in the "Glass and Glazing" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

## 3.5 PROTECTION

A. **Institute protective measures** required throughout the remainder of the construction period to ensure that curtain wall systems will be without damage or deterioration, other than normal weathering, at time of acceptance.

**END OF SECTION**

# SECTION 08 6200

# INSULATED TRANSLUCENT PANEL SYSTEM

## PART 1 - GENERAL

### 1.1 DESCRIPTION

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

### 1.2 SUMMARY

A. **Work included**: Supply all labor and materials required to deliver and install the insulated translucent panel system:
   1. Prefabricated **insulated translucent sandwich panels**.
      a. **Provide system to match existing.**

B. **Related work** specified elsewhere:
   1. **Division 5** Section "**Structural Steel**".
   2. **Division 5** Section "**Miscellaneous Metal**".
   3. **Division 7** Section "**Joint Sealants**".

### 1.3 QUALITY ASSURANCE

A. **Manufacturer's and Erector's Qualifications**
   1. **Material and products** shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
   2. **Panel system must be listed** by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
   3. **Quality control inspections** shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 “Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems” as issued by the ICC-ES.
   4. **Erection** shall be by installer which has been in the business of erecting similar materials for at least 2 years and can show evidence of satisfactory completion of projects of similar size, scope and type.

B. **Performance Requirements**: The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Standard skylight system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.

## 1.4 SUBMITTALS

A. Submit **shop drawings** and color samples in accordance with Division 1 Section "Submittals."

B. Furnish **test reports** in accordance with Division 1 Section "Submittals." Manufacturer shall submit certified test reports independently verified for each type and class of panel system. Reports shall verify that the material will meet all performance requirements of this specification. Previously complete test reports will be acceptable if current and indicative of products used on this project. Test reports required are:

1. IBC Evaluation report.
2. Flame Spread and Smoke Developed (ASTM E-84 by UL 723) - Submit UL Card.
3. Burn Extent (ASTM D-635)
4. Color Difference (ASTM D-2244)
5. Erosion Resistance (ASTM D-4060)
6. Impact Strength (UL 792
7. Tensile Bond Strength (ASTM C-297) after aging by ASTM D-1037.
8. Shear Bond Strength (ASTM D-1002) after five (5) separate conditions
9. Accelerated Aging (ASTM D-1037)
10. Insulation "U" Factor (by NFRC-100; ASTM C-236, E-1423, and C-1199)
11. Beam Bending Strength (ASTM E-72)
12. **NFRC Certification,** based on NFRC 100-97 and 200-95.
13. Condensation Resistance Factor (AAMA 1503.1)
14. Class A Roof Covering Burning Brand (ASTM E-108)

## 1.5 PRODUCT HANDLING

A. **Store** translucent panels on the long edge, several inches above the ground, blocked and under cover to prevent warping.

## 1.6 WARRANTY

A. **Submit** manufacturer's standard one-year material and workmanship warranty. Include manufacturer's limited 25-year warranty against fiber-bloom exposure, non pro-rata. Assembler of skylight components may not warranty face sheets, written warranty must come from original manufacturer of face sheets.

# PART 2 - MATERIALS

## 2.1 TRANSLUCENT FACING

A. **Translucent faces** shall be manufactured from glass fiber reinforced thermoset resins by insulated panel system fabricator specially for architectural use. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable. Faces shall not contain or have applied protective films that will peel off.

B. **Flammability**: The interior face sheet shall have a flame spread rating no greater than 50 and smoke developed no greater than 250 when tested in accordance with ASTM E-84. Burn extent by ASTM D-635 shall be no greater than 1". The system shall have achieved a Class "A" Burning Brand as per ASTM E-108.

1. Material shall not, nor observations made of material distorting, melting, or dripping when exposed to fire, heat or flame. (ASTM E-84). Poly carbonate or acrylics are not acceptable.

C. **Weatherability**:

1. **The full thickness of the exterior face** shall not change color more than 3.0 Hunter or CIE Units (DELTA E by ASTM D-2244) after five (5) years to insure maximum, long term color stability.
   a. An exterior white face sheet shall not darken more than .2 Units (DELTA L by ASTM D-2244) when exposed to 150 degrees F for two (2) weeks.
2. **The exterior face** shall have a permanent glass erosion barrier embedded beneath the surface to provide maximum long-term resistance to reinforcing fiber exposure. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D-4060-90 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles.
   a. The exterior face sheet shall have a self-cleaning surface fully field restorable if worn or damaged.

D. **Appearance**:

1. **The face sheets** shall be uniform in color to prevent splotchy appearance. Faces shall be completely free of ridges and wrinkles which prevent proper surface contact in bonding to the aluminum grid core. Clusters of air bubbles/pinholes which collect moisture and dirt will not be acceptable.
2. **Exterior face sheets** shall be smooth .070" thick. Interior face sheets shall be .045" thick. Faces shall not vary more than +10% in thickness.
   a. **Colors: Match existing.**

E. **Strength**: The exterior face sheet shall be uniform in strength and repel an impact equal to 60 ft. lbs. without fracture or tear in accordance with SIP Shatter Resistance Test.

## 2.2 THERMALLY BROKEN GRID CORE

A. Thermally broken composite grid core shall have minimum Condensation Resistance Factor of 80 by AAMA 1503.1 measured on the grid frame for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material. Width of I-beam shall be no less than 7/16". Aluminum I-beam grid shall be machined to tolerances of not greater than +.002". Aluminum I-beams shall be 6063-T6 or 6005-T5.

## 2.3 ADHESIVE

A. **The laminate adhesive** shall be heat and pressure resin type engineered for structural sandwich panel use. Adhesive shall pass testing requirements specified by the International Conference of Building Officials "Acceptance Criteria for Sandwich Panel Adhesive".

B. **Minimum strength** shall be 750 PSI tensile strength by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.

C. **Minimum shear strength** of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:

1. 50% Relative Humidity at 73 F: 540 PSI
2. 182 F: 100 PSI
3. Accelerated Aging by ASTM D-1037 at room temperature: 800 PSI
4. Accelerated Aging by ASTM D-1037 at 182 F: 250 PSI

## 2.4 PANEL CONSTRUCTION

A. **Panels** shall have a thickness of **2-3/4"** with a **"U" factor of 0.23**, thermally broken by NFRC Certified laboratory, light transmission of 20% and solar heat gain coefficient of 0.27. Complete system shall be NFRC Certified.

B. **Translucent panels** shall be a true sandwich panel of flat fiberglass sheets bonded to a grid core of mechanically interlocking aluminum I-beams and shall be laminated under a controlled process of heat and pressure. Tape bond systems are not allowed.

C. **All grid patterns** shall match existing and be symmetrical about the horizontal center line of each panel.

D. **The adhesive bonding line** shall be straight, cover the entire width of the I-beam and have a neat, sharp edge. In order to insure bonding strength, white spots at intersections of muntins and mullions shall not exceed four (4) for each forty (40) square feet of panel, nor shall they be more than 7/16 inch in width.

E. **Skylight panels** and aluminum perimeter frame shall be pre-assembled where practical and sealed at the factory. Panels shall be shipped to the job site ready for erection.

## 2.5 BATTENS AND PERIMETER CLOSURE SYSTEM

A. **Extruded** 6063-T6 and 6063-T5 aluminum.
   1. Provide thermally broken closures and battens.

B. **Aluminum closures** to be supplied with 300 series stainless steel screws (excluding final fasteners to the building) and shall be factory sealed to the panels. Aluminum battens and cap plates shall be field installed.

C. **All exposed aluminum** to be architectural corrosion resistant finish which meets the performance requirements to ANSI/AAMA 605.2-85, color to be selected from manufacturer's standards.

## 2.6 WELDED CORNERS

A. **Factory pre-assembled corners** shall be welded, attached and pre-sealed to the panels.

## 2.7 FLEXIBLE SEALING TAPE

A. **Sealing tape** shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. **The general contractor** shall prepare openings including isolating dissimilar materials from aluminum system which may cause damage by electrolysis.

## 3.2 ERECTION

A. **The erector** shall erect translucent panel system in strict accordance with approved shop drawings as supplied by manufacturer. Fastening and sealing shall be in strict accordance with manufacturer's shop drawings. All aluminum shall be cleaned before sealants are applied.

B. **After other trades have completed work** on adjacent materials, carefully inspect translucent panel installation and make adjustments necessary to insure proper installation and weather-tight conditions.

C. **All staging**, lifts and hoists required for the complete insulated panel installation, including staging, etc., necessary for field measuring, shall be provided by, set up and maintained by the erection contractor.

## 3.3 FIELD QUALITY CONTROL

A. Test translucent panel systems in accordance with Division 1 Sections "Building Enclousre Commissioning Requirements" and "Building Enclosure Functional Testing Requirements".

## 3.4 CLEANING

A. **Clean the completed system**, inside and out, promptly after installation, exercising care to avoid damage to coatings.

## 3.5 PROTECTION

A. **Institute protective measures** required throughout the remainder of the construction period to ensure that translucent panel systems will be without damage or deterioration, other than normal weathering, at time of acceptance.

**END OF SECTION**

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# SECTION 08 6220

# TUBULAR SKYLIGHTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **Section Includes**:
1. **Solar Tube Day-Lighting System,** consisting of roof dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings.

B. **Related Sections**:
1. **Division 6** Section "**Miscellaneous Carpentry**" for wood framing and blocking at unit skylights.
2. **Division 7** Section "**Sheet Metal Flashing and Trim**" for flashing at unit skylights.
3. **Division 7** Section " **Thermoplastic Membrane Roofing**"

### 1.3 PERFORMANCE REQUIREMENTS

A. **Test Performance Criteria**: Provide tubular skylights capable of complying with performance requirements indicated, based on testing manufacturer's tubular skylights that are representative of those specified.
1. **Uniform Load Test:**
   a. No breakage, permanent damage to fasteners, hardware parts, or damage to make day lighting system inoperable or cause excessive permanent deflection of any section when tested at a positive load of 150 psf (7.18 kPa) or negative load of 70 psf (3.35 kPa).
   b. All units shall be tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
2. **Air Infiltration**: Provide unit skylights with maximum air leakage through assembly of 0.3 cfm/sq. ft. (1.5 L/s per sq. m) when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
3. **Water Resistance Test**: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of tubular skylight indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for tubular skylights.

B. **Shop Drawings**: For tubular skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
   1. Provide manufacturer's standard installation instructions for all tubular skylight types used on Project.
   2. Tubular Skylight Operating System: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, mounting, and grounding provisions.

C. **Samples for Selection**: For tubular skylights with factory-applied color finishes.

D. **Product Test Reports**: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, performance class, performance grade, and size of tubular skylight. Test results based on use of downsized test units will not be accepted.
   1. Furnish **NFRC** certification based on NFRC 100-97 and 200-95.

E. **Maintenance Data**: For tubular skylights to include in maintenance manuals.

F. **Warranty**: Sample of special warranty.

## 1.5 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A manufacturer capable of fabricating tubular skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. **Installer Qualifications**: An installer acceptable to tubular skylight manufacturer for installation of units required for this Project.

C. **Source Limitations**: Obtain tubular skylights from single source from single manufacturer.

D. **Surface-Burning Characteristics of Plastic Glazing**: Provide plastic glazing sheets identical to those tested for fire-exposure behavior per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Self-Ignition Temperature: 650 deg F (343 deg C) or more for plastic sheets in thickness indicated when tested per ASTM D 1929.
   2. Smoke-Production Characteristics: Comply with either requirement below:
      a. Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic sheets in manner indicated for use.
      b. Smoke Density: 75 or less when tested per ASTM D 2843 on plastic sheets in thickness indicated for use.
   3. Burning Characteristics: Tested per ASTM D 635.
      a. Acrylic Glazing: Class CC2, burning rate of 2-1/2 inches (64 mm) per minute or less for nominal thickness of 0.060 inch (1.5 mm) or thickness indicated for use.

E. **Preinstallation Conference**: Conduct conference at Project site.

## 1.6 COORDINATION

A. Coordinate tubular skylight flashing requirements with roofing system.

B. Coordinate sizes and locations of site-built curbs with actual tubular skylights provided.

C. Provide anchors and inserts to be placed in adjacent construction in proper sequence so as not to delay the Work.

## 1.7 WARRANTY

A. **Special Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of tubular skylights that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Uncontrolled water leakage.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Yellowing of acrylic glazing.
   2. **Warranty Period**: Ten years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Solatube International, Inc.
   2. **Product:** Solatube SolaMaster Series 21-inch; S21O-DA-FCM-L2.

B. **Available 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. Solatube International, Inc.; www.solatube.com
   2. Velux USA; www.veluxusa.com
   3. Carlisle; www.carlislesyntec.com

## 2.2 MATERIALS

A. **Aluminum Components**:
   1. Sheets: ASTM B 209 (ASTM B 209M), alloy and temper to suit forming operations and finish requirements but with not less than the strength and durability of alclad Alloy 3005-H25.
   2. Extruded Shapes: ASTM B 221 (ASTM B 221M), alloy and temper to suit structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.

B. **Fasteners**: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.
   1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

## 2.3 GLAZING

A. **Acrylic Glazing**: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).
   1. Single-Glazing Profile: Dome, 25 percent rise.
      a. Thickness: Not less than thickness required to exceed performance requirements.
      b. Color: Colorless, transparent.

B. **Glazing Gaskets**: Manufacturer's standard.

## 2.4 INSTALLATION MATERIALS

A. **Joint Sealants**: As specified in Division 7 Section "Joint Sealants."

B. **Mastic Sealant**: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

## 2.5 TUBULAR SKYLIGHTS

A. **Tubular Skylights General** : Transparent roof-mounted skylight dome, reflective tube, and open ceiling diffuser assembly, transferring sunlight to interior spaces; complying with ICBO/ICC AC-16. All components made and assembled by one manufacturer.

B. **Transparent, UV and impact resistant dome** with flashing base supporting dome and top of tube.
   1. **Roof Dome Assembly**:
      a. **Glazing**: 0.143 inch (3.7 mm) minimum thickness injection molded acrylic classified as CC2 material and meeting characteristics of Duradome DR-101 blend.
      b. Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
      c. Inner Dome Glazing: Type DAI, 0.115 inch (3 mm) minimum thickness acrylic classified as CC2 material.
   2. **Light Intercepting Transfer Device** (LITD®): Aluminum sheet, thickness 0.015 inch (0.4mm) with Spectralight Infinity. Positioned in dome to capture low angle sunlight.
   3. **Roof Flashing Base**: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
      a. **Base Style**: Curb mounted, with flashing with inside diameter 27.25 inches (692 mm) by 27.25 inches (692 mm) to cover curb by others.
   4. **Dome Ring**: Attached to top of base section; 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
   5. **Dome Seal**: Polypropylene Fiber Pile weather - strip 0.27 inch (6.85mm) by 0.27 inch (6.85mm).

6. **Reflective Tube**: Aluminum sheet, thickness 0.018 inch (0.5 mm).
   a. **Interior Finish**: Spectralight Infinity high reflectance specular finish on exposed reflective surface; specular reflectance 99 percent for visible spectrum, less than 93 percent for total solar spectrum.
   b. **Color**: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
   c. **Reflective 30 degree adjustable tube** with aluminum sheet, thickness of 0.018 inch (0.5 mm).
      1) Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface; specular reflectance of 99% for visible spectrum, less than 93% for total solar spectrum.
7. **Diffuser Assemblies for Tubes Not Penetrating Ceilings** (No Ceiling): 21 inch (533 mm) diameter diffuser attached directly to the bottom of the tube.
   a. **Lens**: curved prismatic lens of molded acrylic plastic classified as CC2,0.100 inch (2.5 mm) minimum thickness, minimum light transmission of 90 percent at thickness of 0.100 inch (2.5 mm)
   b. **Seal**: Closed cell polyethylene foam, 3 pounds per cubic foot (48 kg per cubic meter), and white polyvinyl chloride seal butt joint welded, EPDM rubber, or silicone foam.
   c. **Open ceiling trim ring**: Galvanized bare steel. Nominal thickness of .040 inches.

## 2.6 GENERAL FINISH REQUIREMENTS

A. **Comply** with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Appearance of Finished Work**: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

A. **Clear Anodic Finish**: AAMA 611, AA-M12C22A41, 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 the Work.

B. Proceed with tubular skylight installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. **Coordinate installation** of tubular skylight with installation of substrates, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weather tight.

B. **Install tubular skylights level**, plumb, and true to line, without distortion.

C. **Anchor tubular skylights securely** to supporting substrates.

D. Where metal surfaces of tubular skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, **apply bituminous coating on concealed metal surfaces**, or provide other permanent separation recommended in writing by tubular skylight manufacturer.

E. **Set tubular skylight flanges** in thick bed of roofing cement to form a seal unless otherwise indicated.

F. Where cap flashing is indicated, **install to produce waterproof overlap** with roofing or roof flashing. Seal with thick bead of mastic sealant except where overlap is indicated to be left open for ventilation.

## 3.3 FIELD QUALITY CONTROL

A. **Test tubular skylights** in accordance with Division 1 Sections "Building Enclousre Commissioning Requirements" and "Building Enclosure Functional Testing Requirements".

## 3.4 CLEANING

A. **Clean exposed tubular skylight surfaces** according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. **Remove excess sealants**, glazing materials, dirt, and other substances.

C. **Remove and replace glazing** that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. **Protect tubular skylight surfaces** from contact with contaminating substances resulting from construction operations.

## 3.5 PROTECTION

A. **Institute protective measures** required throughout the remainder of the construction period to ensure that translucent panel systems will be without damage or deterioration, other than normal weathering, at time of acceptance.

**END OF SECTION**

# SECTION 08 7100
# DOOR HARDWARE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** commercial door hardware for the following:
   1. Swinging doors.
   2. Sliding doors.
   3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Cylinders specified for doors in other sections.

C. **Related Sections:**
   1. Section 08 06 71 – Door Hardware Schedule.
   2. Section 08 11 13 – Hollow Metal Doors and Frames.
   3. Section 08 14 16 – Flush Wood Doors.

D. **Codes and References**: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 80 - Fire Doors and Windows.
   4. NFPA 101 - Life Safety Code.
   5. NFPA 105 - Installation of Smoke Door Assemblies.
   6. State Building Codes, Local Amendments.

E. **Standards**: All hardware specified herein shall comply with the following industry standards:
   1. ANSI/BHMA Certified Product Standards - A156 Series
   2. UL10C – Positive Pressure Fire Tests of Door Assemblies

### 1.3 SUBMITTALS

A. **Product Data:** Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. **Door Hardware Schedule**: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. **Format**: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. **Organization:** Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. **Content:** Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.

4. **Submittal Sequence**: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. **Shop Drawings**: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. **Keying Schedule**: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

E. **Operating and Maintenance Manuals**: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. **Warranties and Maintenance**: Special warranties and maintenance agreements specified in this Section.

## 1.4 QUALITY ASSURANCE

A. **Manufacturers Qualifications**: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. **Installer Qualifications**: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. **Door Hardware Supplier Qualifications**: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
   1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. **Source Limitations**: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. **Regulatory Requirements**: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
   1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (**ADA**), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
      a. **Handles, Pulls, Latches, Locks, and other Operating Devices**: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
      b. **Door Closers**: Comply with the following maximum opening-force requirements indicated:
         1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
         2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
      c. **Thresholds:** Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
   3. **NFPA 101**: Comply with the following for means of egress doors:
      a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
      b. Thresholds: Not more than 1/2 inch high.
   4. **Fire-Rated Door Assemblies**: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
      a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. **Keying Conference**: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

H. **Pre-Submittal Conference**: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, arrange for manufacturers' representatives to hold a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
   3. Review sequence of operation narratives for each unique access controlled opening.
   4. Review and finalize construction schedule and verify availability of materials.
   5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, **provide written documentation** that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Inventory door hardware** on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. **Tag each item** or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. **Deliver**, as applicable, **permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner** via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

## 1.6 COORDINATION

A. **Templates**: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. **Door Hardware and Electrical Connections**: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. **Door and Frame Preparation**: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

## 1.7 WARRANTY

A. **General Warranty:** Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Warranty Period:** Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
   1. Structural failures including excessive deflection, cracking, or breakage.
   2. Faulty operation of the hardware.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Electrical component defects and failures within the systems operation.

C. **Standard Warranty Period**: One year from date of Substantial Completion, unless otherwise indicated.

D. **Special Warranty Periods**:
   1. Ten years for mortise locks and latches.
   2. Seven years for heavy duty cylindrical (bored) locks and latches.
   3. Five years for exit hardware.
   4. Twenty five years for manual door closers.
   5. Two years for electromechanical door hardware.

## 1.8 MAINTENANCE SERVICE

A. **Maintenance Tools and Instructions**: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. **Continuing Service**: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 HANGING DEVICES

A. **Hinges**: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. **Quantity:** Provide the following hinge quantity, unless otherwise indicated:
   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. **Hinge Size**: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
   b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. **Hinge Weight and Base Material:** Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing hinges unless Hardware Sets indicate heavy weight.
   c. Tornado Resistant Assemblies: At a minimum, provide heavy weight hinges with stainless steel screws used in accordance with and specified as part of a Severe Storm Shelter Opening meeting ICC 500 and FEMA 361.
4. **Hinge Options**: Comply with the following where indicated in the Hardware Sets or on Drawings:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
      1) Out-swinging exterior doors.
      2) Out-swinging access controlled doors.
      3) Out-swinging lockable doors.
5. **Acceptable Manufacturers**:
   a. Hager Companies (HA).
   b. Ives (IV).
   c. McKinney Products (MK).

B. **Continuous Geared Hinges**: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. **Acceptable Manufacturers**:
   a. Hager (HA).
   b. Ives (IV).
   c. McKinney Products (MK).
   d. Pemko Manufacturing (PE).
   e. Stanley Hardware (ST).

## 2.2 DOOR OPERATING TRIM

A. **Flush Bolts and Surface Bolts**: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
   1. **Acceptable Manufacturers**:
      a. Hager (HA).
      b. Ives (IV).
      c. Rockwood Manufacturing (RO).
      d. Trimco (TC).

B. **Coordinators**: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Coordinators fabricated from steel with nylon-coated strike plates and built-in adjustable safety release.
   1. **Acceptable Manufacturers**:
      a. Hager (HA).
      b. Ives (IV).
      c. Rockwood Manufacturing (RO).
      d. Trimco (TC).

C. **Door Push Plates and Pulls:** ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
   1. **Push/Pull Plates**: Minimum .050 inch thick, 4-inches wide by 16-inches high, with square corners and beveled edges, secured with exposed screws unless otherwise indicated.
   2. **Straight Pull Design**: Minimum 1-inch round diameter stainless steel bar or tube stock pulls with 2 1/2-inch projection from face of door unless otherwise indicated.
   3. **Offset Pull Design**: Minimum 1-inch round diameter stainless steel bar or tube stock pulls with 2 1/2-inch projection and offset of 90 degrees unless otherwise indicated.
   4. **Push Bars**: Minimum 1-inch round diameter horizontal push bars with minimum clearance of 2 1/2-inch projection from face of door unless otherwise indicated.
   5. **Fasteners:** Provide manufacturer's designated fastener type as indicated in Hardware Sets.
      a. **Acceptable Manufacturers**:
         1) Hager (HA).
         2) Ives (IV).
         3) Rockwood Manufacturing (RO).
         4) Trimco (TC).

## 2.3 CYLINDERS AND KEYING

A. **General:** Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. **Source Limitations**: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. **Cylinders**: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. **High Security Cylinders**: High security cylinder conforming to UL437, including both pick and drill resistance. Pick resistance incorporates two or more independent locking mechanisms including a pin tumbler device with six top pin chambers, mushroom-shaped driver pins, and coded sidebar locking mechanism operated independently from the six top pin tumbler device. Drill resistance incorporates cylinder housing with fixed case-hardened inserts protecting the pin tumbler shear line, cylinder plugs with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel sidepins. Cylinders to be factory keyed.
1. **Acceptable Manufacturers**:
   a. ASSA (AS) – V10 Series.

E. **Keying System**: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
1. **Master Key System**: Cylinders are operated by a change key and a master key.
2. **Grand Master Key System**: Cylinders are operated by a change key, a master key, and a grand master key.
3. **Great-Grand Master Key System:** Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
4. **Existing System**: Master key or grand master key locks to Owner's existing system.
5. **Keyed Alike:** Key all cylinders to same change key.

F. **Key Quantity**: Provide the following minimum number of keys:
1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Control Keys (where required): Two (2)
6. Permanent Control Keys (where required): Two (2)

## 2.4 MECHANICAL LOCKS AND LATCHING DEVICES

A. **Mortise Locksets, Grade 1 (Heavy Duty):** ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
1. **Acceptable Manufacturers**:
   a. Corbin Russwin Hardware (RU) – ML2000 Series.
   b. Sargent Manufacturing (SA) – 8200 Series.
   c. Schlage (SC) – L9000 Series.

B. **Cylindrical Locksets, Grade 1 (Heavy Duty):** ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.

1. **Acceptable Manufacturers**:
    a. Corbin Russwin Hardware (RU) – CL3300 Series.
    b. Sargent Manufacturing (SA) – 10 Line.
    c. Schlage (SC) – ND Series.

C. **Lock Trim Design**: As specified in Hardware Sets.

## 2.5 AUXILIARY LOCKS

A. **Mortise Deadlocks, Small Case**: ANSI/BHMA A156.5, Grade 1, certified small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
1. **Acceptable Manufacturers:**
    a. Corbin Russwin Hardware (RU) - DL4100 Series.
    b. Sargent Manufacturing (SA) - 4870 Series.
    c. Schlage (SC) - L460 Series.

## 2.6 LOCK AND LATCH STRIKES

A. **Strikes**: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. **Flat-Lip Strikes**: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. **Extra-Long-Lip Strikes**: For locks used on frames with applied wood casing trim.
3. **Aluminum-Frame Strike Box**: Provide manufacturer's special strike box fabricated for aluminum framing.

B. **Standards:** Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

## 2.7 CONVENTIONAL EXIT DEVICES

A. **Conventional Push Rail Exit Devices (Heavy Duty):** ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
1. **Acceptable Manufacturers**:
    a. Corbin Russwin Hardware (RU) - ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.
    c. Von Duprin (VD) - 98 Series.

## 2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. **General:** Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. **Standards:** Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. **Size of Units:** Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
4. **Closer Arms:** Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
   b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
   c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
   d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
5. **Closer Accessories**: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. **Door Closers, Surface Mounted (Heavy Duty):** ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units and high impact, non-corrosive plastic covers standard.

1. **Acceptable Manufacturers:**
   a. LCN Closers (LC) - 4040XP Series.
   b. Sargent Manufacturing (SA) - 351 Series.
   c. Norton Door Controls (NO) - 7500 Series.

## 2.9 ARCHITECTURAL TRIM

A. **Door Protective Trim**

1. **General**: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. **Size:** Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. **Metal Protection Plates**: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following.
   a. Stainless Steel: 050-inch thick, with countersunk screw holes (CSK).
   b. Brass or Bronze: 050-inch thick, with countersunk screw holes (CSK).
   c. Laminate Plastic or Acrylic: 1/8-inch thick, with countersunk screw holes (CSK).
4. **Fasteners**: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. **Metal Door Edging**: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
6. **Acceptable Manufacturers**:
   a. Hager (HA).
   b. Ives (IV).
   c. Rockwood Manufacturing (RO).
   d. Trimco (TC).

## 2.10 DOOR STOPS AND HOLDERS

A. **General:** Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. **Door Stops and Bumpers:** ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. **Acceptable Manufacturers:**
      a. Hager (HA).
      b. Ives (IV).
      c. Rockwood Manufacturing (RO).
      d. Trimco (TC).

C. **Overhead Door Stops and Holders**: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
   1. **Acceptable Manufacturers**:
      a. ABH Manufacturing (AB).
      b. Rixson Door Controls (RF).
      c. Sargent Manufacturing (SA).

## 2.11 ARCHITECTURAL SEALS

A. **General:** Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. **Smoke Labeled Gasketing:** Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. **Fire Labeled Gasketing**: :Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. **Sound-Rated Gasketing**: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. **Replaceable Seal Strips**: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. **Acceptable Manufacturers**:
   1. Pemko Manufacturing (PE).
   2. Reese Enterprises, Inc. (RS).
   3. National Guard (NG).

## 2.12 FABRICATION

A. **Fasteners:** Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine scheduled openings**, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify Architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

## 3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

## 3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. **Mounting Heights**: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. **Retrofitting:** Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. **Thresholds:** Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. **Storage:** Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

## 3.4 FIELD QUALITY CONTROL

A. **Field Inspection**: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

## 3.5 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.

## 3.6 CLEANING AND PROTECTION

A. **Protect all hardware** stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. **Clean adjacent surfaces** soiled by door hardware installation.

C. **Clean operating items** as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

## 3.7 DEMONSTRATION

A. **Instruct Owner's maintenance personnel** to adjust, operate, and maintain mechanical and electromechanical door hardware.

## 3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the Owner and Architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the Architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RU - Corbin Russwin
3. RO - Rockwood
4. AA - ASSA High Security Locks
5 NO - Norton
6. RF - Rixson
7. PE – Pemko
8. EL - ELMES

**Hardware Schedule**

**Set: 1.0**
Doors: 100A, 100A1

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Removable Mullion | 907 | | RU |
| 1 | Exit Device | ED5200 K157 | 630 | RU |
| 1 | Exit Device | ED5200 | 630 | RU |
| 2 | Custom Pull | G3062-01-003-B | US26D | EL |
| 2 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 2 | Door Closer | CPS7500 (7788 6891 as required) | 689 | NO |
| 1 | Threshold | 271A | | PE |
| 2 | Sweep | 18061CNB | | PE |
| 1 | Gasketing | by door mfg. | | |

**Set: 2.0**
Doors: 100

| | | | | |
|---|---|---|---|---|
| 2 | Cylinder | (Assa V-10 as required) | 626 | AA |

**Set: 3.0**
Doors: 102F, 102G, 102H

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Removable Mullion | 907 | | RU |
| 2 | Exit Device | ED5200 | 630 | RU |
| 2 | Door Closer | CPS7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Threshold | 271A | | PE |
| 1 | Gasketing | 45041CNB | | PE |
| 2 | Sweep | 18061CNB | | PE |
| 1 | Meeting Stile Astragal | 18041CNB | | PE |

**Set: 4.0**
Doors: 250

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Exit Device | ED5470B M55 | 630 | RU |
| 1 | Exit Device | ED5470B N959 M55 | 630 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 2 | Magnetic Hold Open | 998 | 689 | RF |
| 2 | Door Closer | CPS7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Threshold | 271A | | PE |
| 1 | Gasketing | 45041CNB | | PE |
| 2 | Sweep | 18061CNB | | PE |
| 1 | Meeting Stile Astragal | 18041CNB | | PE |

**Set: 5.0**
Doors: 199C

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Exit Device | ED5200A | 630 | RU |
| 1 | Vandal Resistant Trim | VRT26C | US32D | RO |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | CPS7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Threshold | 271A | | PE |
| 1 | Gasketing | 45041CNB | | PE |
| 1 | Sweep | 18061CNB | | PE |

**Set: 6.0**
Doors: 150, 150A

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Exit Device | ED5470B M55 | 630 | RU |
| 1 | Exit Device | ED5470B N959 M55 | 630 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 2 | Door Closer | CPS7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Threshold | 271A | | PE |
| 1 | Gasketing | 45041CNB | | PE |
| 2 | Sweep | 18061CNB | | PE |
| 1 | Meeting Stile Astragal | 18041CNB | | PE |

**Set: 7.0**
Doors: 103A, 103B, 103B1

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Flush Bolt Set (HM) | 2845 | US26D | RO |
| 1 | Dust Proof Strike | 570 | US26D | RO |
| 1 | Mortise Lock | ML2057 NSA LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Coordinator | 1700 | Black | RO |
| 2 | Door Closer | CPS7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Threshold | 271A | | PE |
| 1 | Gasketing | 45041CNB | | PE |
| 2 | Sweep | 18061CNB | | PE |
| 1 | Astragal | 357C | | PE |

**Set: 8.0**
Doors: 102B, 102C, 102D, 102E

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Removable Mullion | 907 | | RU |
| 1 | Exit Device | ED5200 K157 | 630 | RU |
| 1 | Exit Device | ED5200 | 630 | RU |
| 2 | Custom Pull | G3062-01-003-B | US26D | EL |
| 2 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 2 | Door Closer | CPS7500 (7788 6891 as required) | 689 | NO |
| 1 | Gasketing | by door mfg. | | |

**Set: 9.0**
Doors: 101, 202, 202C, 203B, 203C

| | | | | |
|---|---|---|---|---|
| 1 | Continuous Hinge | MCK-12HD | CL | MK |
| 1 | Exit Device | ED5200 | 630 | RU |
| 1 | Vandal Resistant Trim | VRT26C | US32D | RO |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | CPS7500 (7788 6891 as required) | 689 | NO |
| 1 | Gasketing | by door mfg. | | |

**Set: 10.0**
Doors: 121

| | | | | |
|---|---|---|---|---|
| 6 | Hinge | T4A3786 | US26D | MK |
| 1 | Removable Mullion | 907A | | RU |
| 2 | Exit Device | ED5200A | 630 | RU |
| 2 | Vandal Resistant Trim | VRT26C | US32D | RO |
| 2 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 2 | Door Closer | PR7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 2 | Wall Stop | 415 | US26D | RO |
| 1 | Gasketing | S773BL | | PE |
| 1 | Meeting Stile Astragal | 18041CNB | | PE |

**Set: 11.0**
Doors: 299C, 399C

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Exit Device | ED5200A N955 | 630 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | CPS7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 415 | US26D | RO |
| 1 | Gasketing | S773BL | | PE |

**Set: 12.0**
Doors: 103A1, 103B2

| | | | | |
|---|---|---|---|---|
| 6 | Hinge | T4A3786 | US26D | MK |
| 1 | Flush Bolt Set (HM) | 2845 | US26D | RO |
| 1 | Dust Proof Strike | 570 | US26D | RO |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | 7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 2 | Wall Stop | 406 | US32D | RO |
| 2 | Silencer | 608 | | RO |

**Set: 13.0**
Doors: 103G, 103L, 103M, 103P

| | | | | |
|---|---|---|---|---|
| 6 | Hinge | T4A3786 | US26D | MK |
| 1 | Flush Bolt Set (HM) | 2845 | US26D | RO |
| 1 | Dust Proof Strike | 570 | US26D | RO |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Coordinator | 1700 | Black | RO |
| 2 | Door Closer | 7500 | 689 | NO |
| 2 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 2 | Wall Stop | 406 | US32D | RO |
| 1 | Gasketing | S773BL | | PE |
| 1 | Meeting Stile Astragal | 18041CNB | | PE |

**Set: 14.0**
Doors: 200CX, 202A, 202B, 203A, 208

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 15.0**
Doors: 101A, 101AB, 105, 105A

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Surface OH Stop | 10-X36 | 630 | RF |
| 3 | Silencer | 608 | | RO |

**Set: 16.0**
Doors: 209, 209B

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | 7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 17.0**
Doors: 102A, 103P, 201

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | 7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 18.0**
Doors: 103H, 103K, 103N

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Cylindrical Lock | CL3357 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | 7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 406 | US32D | RO |
| 1 | Gasketing | S773BL | | PE |

**Set: 19.0**
Doors: 101D, 101E, 101F, 101G, 105B, 105C, 210A, 210B, 210E, 210F

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3351 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Wall Stop | 409 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 20.0**
Doors: 109, 210

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Cylindrical Lock | CL3355 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | PR7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 21.0**
Doors: 110

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Cylindrical Lock | CL3355 NZD LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Door Closer | CPS7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 22.0**
Doors: 101B, 210C

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3310 NZD | 626 | RU |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 23.0**
Doors: 101B1

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | TA2714 | US26D | MK |
| 1 | Cylindrical Lock | CL3310 NZD | 626 | RU |
| 1 | Surface OH Stop | 10-X36 | 630 | RF |
| 1 | Wall Stop | 406 | US32D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 24.0**
Doors: 206, 207

| | | | | |
|---|---|---|---|---|
| 3 | Hinge | T4A3786 | US26D | MK |
| 1 | Deadbolt | DL4117 LC | 626 | RU |
| 1 | Cylinder | (Assa V-10 as required) | 626 | AA |
| 1 | Push Plate | 70F | US32D | RO |
| 1 | Pull Plate | 111x70C | US32D | RO |
| 1 | Door Closer | PR7500 | 689 | NO |
| 1 | Kick Plate | K1050 10" x 2" LDW | US32D | RO |
| 1 | Wall Stop | 415 | US26D | RO |
| 3 | Silencer | 608 | | RO |

**Set: 25.0**
Doors: 199D, 199E, 211, 3E1, 3E1A

| | | |
|---|---|---|
| 1 | Hardware | by door mfg. |

**END OF SECTION**

# SECTION 08 8000

# GLAZING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. **Glazing in curtain walls and storefront systems**.
2. **Doors.**
3. **Glazed** entrances.
4. Interior **borrowed** lites.

B. **Related Sections**:
1. **Division 5** Section "**Metal Fabrications**" for aluminum **glazing channels** at interior locations.
2. **Division 8** Section "**Decorative Glass**" for sand-blasted glass.

### 1.3 DEFINITIONS

A. **Manufacturer**: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

B. **Interspace**: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

C. **Deterioration of Coated Glass**: Defects developed 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 the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and 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 thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. **Glass Thicknesses**: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
   a. **Specified Design Wind Loads**: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.
   b. **Specified Design Snow Loads**: As indicated, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads."
   c. **Probability of Breakage for Vertical Glazing**: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
      1) Load Duration: 60 seconds or less.
   d. **Maximum Lateral Deflection:** For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
      1) For monolithic-glass lites heat treated to resist wind loads.
      2) For insulating glass.
   e. **Minimum Glass Thickness for Exterior Lites**: Not less than 6 mm.
   f. **Thickness of Tinted and Heat-Absorbing Glass:** Provide the same thickness for each tint color indicated throughout Project.

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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. **Thermal and Optical Performance Properties**: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. **For monolithic-glass lites**, properties are based on units with lites 6 mm thick.
2. **For insulating-glass units**, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- (13-mm-) wide interspace.
3. **Center-of-Glass U-Values**: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
4. **Center-of-Glass Solar Heat Gain Coefficient**: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
5. **Solar Optical Properties:** NFRC 300.

## 1.5 SUBMITTALS

A. **Product Data:** For each glass product and glazing material indicated. Include insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures

B. **Samples**: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
   1. Each color of tinted float glass.
   2. Coated vision glass.
   3. Insulating glass for each designation indicated.
   4. For each color (except black) of exposed glazing sealant indicated.

C. **Glazing Schedule**: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. **Product Certificates**: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. **Preconstruction Adhesion and Compatibility Test Report**: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

F. **Product Test Reports**: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:
   1. **Coated** float glass.
   2. **Insulating** glass.
   3. Glazing **sealants**.
   4. Glazing **gaskets**.

G. **Warranties**: Special warranties specified in this Section.

## 1.6 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.

B. **Source Limitations for Clear Glass**: Obtain clear float glass from one primary-glass manufacturer.

C. **Source Limitations for Tinted Glass:** Obtain tinted, heat-absorbing, and light-reducing float glass from one primary-glass manufacturer for each tint color indicated.

D. **Source Limitations for Coated Glass**: Obtain coated glass from one manufacturer for each type of coating and each type of class of float glass indicated.

E. **Source Limitations for Insulating Glass**: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.

F. **Source Limitations for Glazing Accessories**: Obtain glazing accessories from one source for each product and installation method indicated.

G. **Glass Product Testing:** Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
   1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

H. **Elastomeric Glazing Sealant Product Testing**: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. **Sealant Testing Agency Qualifications**: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. **Test elastomeric glazing sealants** for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

I. **Preconstruction Adhesion and Compatibility Testing**: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glass type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants.
   1. **Use manufacturer's standard test methods** to determine whether priming and other specific preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
      a. **Perform tests** under normal environmental conditions replicating those that will exist during installation.
   2. **Submit not fewer than nine pieces** of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, and insulating units) as well as one sample of each glazing accessory (gaskets, tape sealants, setting blocks, and spacers).
   3. **Schedule** sufficient time for testing and analyzing results to prevent delaying the Work.
   4. **For materials failing tests**, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
   5. **Testing will not be required** if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

J. **Fire-Rated Door Assemblies**: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities have jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

K. **Fire-Rated Window Assemblies**: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

L. **Safety Glass**: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
   1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

M. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations 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. **GANA Publications**: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
   2. **AAMA Publications**: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
   3. **SIGMA Publications**: SIGMA TM-3000, "Vertical Glazing Guidelines," and SIGMA TB-3001, "Sloped Glazing Guidelines."

N. **Dual Seal Certification Program**: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
   1. Insulating Glass Certification Council.
   2. Associated Laboratories, Inc.
   3. National Accreditation and Management Institute.

O. **Certificate of assembled U-factor and solar heat gain coefficient (SHGC):** The **installer** or **supplier** on the fenestration system (which includes the **glazing (including spacer)** as well as the **aluminum** system) shall provide a **signed** and **dated certificate** for the installed fenestration system listing the assembly **U-factor**, the **solar heat gain coefficient** and the **air leakage rate**. This is to meet the exception to the Labeling of Fenestration Products under **Item 5.8.2.2** of the ANSI/ASHRA/IESNA STANDARD **90.1-2007**. Energy performance of fenestration must be determined based on criteria of NFRC 100 and 200. For LEED submissions or where windows and doors are to be site-built, furnish certificate of overall product performance generated using NFRC Component Modeling Approach software tool (CMAST).
   1. Fenestration systems shall have a **maximum assembly U value of 0.33** and a **maximum SHGC of 0.34**.
   2. Certifications reflecting only the center of glass values are not acceptable.
   3. Once all site-built components have been installed, but prior to final inspection, the **Contractor shall retain an ACE** (Approved Calculation Entity) **to generate the NFRC label certificate** for the project based on the actual products installed.
   4. All costs associated with certification of fenestration systems shall be borne by the contractor.

P. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Protect glazing materials** according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. **For insulating-glass units** that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

## 1.8 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. **Do not install liquid glazing sealants** when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

## 1.9 WARRANTY

A. **General Warranty**: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Manufacturer's Special Warranty on Coated-Glass Products**: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for coated-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.

C. **Manufacturer's Special Warranty on Insulating Glass**: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for 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 PRODUCTS AND MANUFACTURERS

A. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in **schedules at the end of Part 3.**

## 2.2 PRIMARY FLOAT GLASS

A. **Float Glass**: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

## 2.3 HEAT-TREATED FLOAT GLASS

A. **Fabrication Process**: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

B. **Heat-Treated Float Glass:** ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

## 2.4 COATED FLOAT GLASS

A. **General:** Provide coated glass complying with requirements indicated in this Article and in schedules at the end of Part 3.
   1. Provide Kind HS (heat-strengthened) coated float glass in place of coated 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 "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

B. **Sputter-Coated Float Glass**: Float glass with metallic-oxide or metallic-nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), complying with requirements specified in schedules at the end of Part 3.

## 2.5 INSULATING GLASS

A. **Insulating-Glass Units**: Preassembled 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 the Insulating-Glass Schedule at the end of Part 3.
   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 "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

B. **Overall Unit Thickness and Thickness of Each Lite**: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

C. **Sealing System**: **Dual seal**, with primary and secondary sealants as follows:
   1. **Primary Seal**: Polyisobutylene.
   2. **Secondary Seal**: Silicone.

D. **Spacer Specifications**: Manufacturer's standard spacer material and construction complying with the following requirements:
   1. **Aluminum** with mill or clear-anodized finish.
   2. **Desiccant**: Molecular sieve or silica gel, or blend of both.
   3. **Corner Construction**: Manufacturer's standard corner construction.

## 2.6 ELASTOMERIC GLAZING SEALANTS

A. **General**: Provide products of type indicated, complying with the following requirements:
   1. **Compatibility**: Select 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. **Colors of Exposed Glazing Sealants**: As selected by Architect from manufacturer's full range for this characteristic.

B. **Elastomeric Glazing Sealant Standard**: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

1. **Additional Movement Capability**: Where additional movement capability is specified in the Glazing Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.

C. **Glazing Sealant for Fire-Resistive Glazing Products**: Identical to product used in test assembly to obtain fire-protection rating.

## 2.7 GLAZING TAPES

A. **Back-Bedding Mastic Glazing Tape**: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; 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.

B. **Expanded Cellular Glazing Tape**: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.8 GLAZING GASKETS

A. **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.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

## 2.9 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 A durometer hardness of 85, plus or minus 5.

D. **Spacers**: Elastomeric blocks or continuous extrusions with a Shore 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).

F. **Cylindrical Glazing Sealant Backing**: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. **Fabricate glass** and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

B. **Clean-cut or flat-grind vertical edges** of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. **Grind smooth** and polish exposed glass edges.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine framing glazing**, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Clean glazing channels** and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. **Examine glazing units** to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

## 3.3 GLAZING, GENERAL

A. **Comply with combined written instructions** of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. **Glazing channel dimensions**, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

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 sealant-substrate 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 the length plus width is larger than 50 inches (1270 mm) as follows:
   1. **Locate spacers directly opposite each other** on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. **Provide 1/8-inch (3-mm) minimum bite of spacers on glass** and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

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.

I. **Set glass lites** in each series with uniform pattern, draw, bow, and similar characteristics.

J. **Set glass lites with proper orientation** so that coatings face exterior or interior as specified.

K. **Where wedge-shaped gaskets are driven into one side of channel** to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. **Square cut wedge-shaped gaskets** at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

M. **Butt-glazing:** Where butt-glazed openings are indicated on the building interior, ensure all joints between glass panels are completely filled and properly tooled with no air pockets or gaps.

## 3.4 TAPE GLAZING

A. **Position tapes** on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. **Install tapes continuously**, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. **Where framing joints are vertical**, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these 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. **Do not remove release paper** from tape until just before each glazing unit is installed.

F. **Apply heel bead** of elastomeric sealant.

G. **Center glass lites in openings** on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. **Apply cap bead** of elastomeric sealant over exposed edge of tape.

## 3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

## 3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

## 3.7 PROTECTION AND CLEANING

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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. **Remove and replace** glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. **Wash glass on both exposed surfaces** in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

## 3.8 MONOLITHIC FLOAT-GLASS SCHEDULE

A. **TYPE 'C'** glass (1/4" Tempered) and **TYPE 'D'** glass (1/4" Float Glass)

B. **Uncoated Clear Float Glass**: Where glass as designated below is indicated, provide Type I (transparent glass, flat), Class 1 (clear) glass lites complying with the following:
   1. **Uncoated Clear Annealed Float Glass**: Annealed or Kind HS (heat strengthened), Condition A (uncoated surfaces) where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with performance requirements.
   2. **Uncoated Clear Heat-Strengthened Float Glass**: Kind HS (heat strengthened).
   3. **Uncoated Clear Fully Tempered Float Glass**: Kind FT (fully tempered). Provide as required and as indicated.

## 3.9 INSULATING-GLASS SCHEDULE

A. **Solar-Control Low-E Insulating-Glass Units**:
   1. Where glass of this designation is indicated, provide insulating-glass units complying with the following:
      a. **Products**: Available products include but are not limited to the following:
         1) **PPG** Industries
            (a) Basis of Design: **SOLARBAN 70XL**.
         2) **Guardian**.
   2. **Overall Unit Thickness**: 1 inch (25mm).
   3. **Thickness of Each Lite**: 1/4 inch (6mm).
   4. **Interspace Content**: Air.

5. **Outdoor Lite**: **SOLARBAN 70XL**.
   a. Provide **HS** (heat strengthened) or **FT** (fully tempered) glass as indicated on the drawings. If **FT** (fully tempered) glass is not indicated on the drawings; but is required by the governing code, provide **FT** (fully tempered) glass.
6. **Indoor Lite**: Class 1 (**clear**) float glass.
   a. Provide **HS** (heat strengthened) or **FT** (fully tempered) glass as indicated on the drawings. If **FT** (fully tempered) glass is not indicated on the drawings; but is required by the governing code, provide **FT** (fully tempered) glass.
7. **Low-E Coating**: MSVD Sputtered on second surface.
8. **Visible Light Transmittance**: 64 percent minimum.
9. **Winter Nighttime U-Factor**: 0.28 maximum.
10. **Summer Daytime U-Factor**: 0.26 maximum.
11. **Solar Heat Gain Coefficient**: 0.27 maximum.
12. **Outdoor Visible Reflectance**: 12 percent maximum.
13. **Shading Coefficient**: 0.32.

## 3.10 GLAZING SEALANT SCHEDULE

A. **Low-Modulus Nonacid-Curing Silicone Glazing Sealant**: Where glazing sealants of this designation are indicated, provide products complying with the following:
   1. **Products**: Available products include the following:
      a. **790;** Dow Corning.
      b. **UltraPruf** SCS2300; GE Silicones.
      c. **Spectrem 1**; Tremco.
   2. **Type and Grade**: S (single component) and NS (nonsag).
   3. **Class**: 25.
   4. **Additional Movement Capability**: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. **Use Related to Exposure**: NT (nontraffic).
   6. **Uses Related to Glazing Substrates**: M, G, A, and, as applicable to glazing substrates indicated, O.
      a. **Use O Glazing Substrates**: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.

B. **Color(s):** As selected by Architect.

**END OF SECTION**

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# SECTION 08 8300

# MIRRORED GLASS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Safety (laminated) mirrored glass.

### 1.3 DEFINITIONS

A. **Deterioration of Silvered Mirrored Glass:** 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 silvered mirrored glass contrary to mirrored glass manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

### 1.4 PERFORMANCE REQUIREMENTS

A. **Provide mirrored glass that will not fail** under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

### 1.5 SUBMITTALS

A. **Product Data:** For the following:
   1. Silvered mirrored glass. Include description of materials and process used to produce mirrored glass that indicates source of glass, glass coating components, edge sealer, and quality-control provisions.
   2. Mirror hardware.

B. **Shop Drawings:** Include elevations, sections, details, and attachments to other Work.

C. **Samples for Verification:** For the following products, in sizes indicated below:
   1. Mirrored glass, 12 inches (300 mm) square, including edge treatment on 2 adjoining edges.
   2. Mirror clips/channels/standoffs.

D. **Product Certificates**: Signed by manufacturers of mirrored glass certifying that products furnished comply with requirements.

E. **Warranties**: Special warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced installer who has completed mirrored glass installations similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Source Limitations for Mirrored Glass**: Obtain mirrored glass from one source for each type of mirrored glass indicated.

C. **Source Limitations for Glazing Accessories:** Obtain glazing accessories from one source for each type of accessory indicated.

D. **Glazing Publications:** Comply with published recommendations in GANA's "Glazing Manual," unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.

E. **NAAMM's Publication**: For silvered mirrored glass, comply with recommendations in NAAMM's "Mirrors, Handle with Extreme Care, Tips for the Professional on the Care and Handling of Mirrors."

F. **Safety Glass**: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. **Protect glazing materials** according to mirrored glass manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For silvered mirrored glass, **comply with mirrored glass manufacturer's written instructions for shipping, storing, and handling** mirrored glass 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.

## 1.8 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install mirrored glass until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

## 1.9 WARRANTY

A. **General Warranty:** Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Manufacturer's Special Warranty for Silvered Mirrored Glass**: Written warranty, made out to Owner and signed by mirrored glass manufacturer agreeing to replace silvered mirrored 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: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LAMINATED MIRRORED GLASS

A. **Silvered Laminated Mirrored Glass**: Total thickness 1/4 inch; composed of 1/8 inch clear glass, 0.030 PVB interlayer, and 1/8 inch ASTM C1503 “Select Quality”-compliant mirror with silvering applied to the 4th surface.

B. **Film Backing for Safety Mirrors**: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

### 2.2 FABRICATION

A. **Mirrored Glass Sizes**: Cut mirrored glass to final sizes and shapes to suit Project conditions.

B. **Cutouts**: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.

C. **Mirrored Glass Edge Treatment**: Treat edges as indicated below.
1. Rounded polished edge.
2. Seal edges of silvered mirrored glass after edge treatment to prevent chemical or atmospheric penetration of glass coating.
3. Require mirrored glass manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

### 2.3 MISCELLANEOUS MATERIALS

A. **Edge Sealer**: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.

B. **Mirror Clips**: Zinc alloy, dull nickel finish, furnished with screw, threaded stud and sleeve for attachment thru glass panel.
1. Equal to: Sugatsune (Lamp), PGM-22 SNI/PGM-21 SNI.

C. **Mirror Channels:** Equal to C.R. Laurence "J" channel for 1/4 inch mirror, #SS960, stainless steel finish as selected by Architect.

D. **Standoff System:** Equal to C.R. Laurence 3/4 inch diameter x 1/4 inch standoff bases; stainless steel finish as selected by Architect.

E. **Mirror Mounting Tape:** Pressure-sensitive foam mounting tape with aggressive synthetic rubber adhesive. Thickness as required to place surface of mirror in same plane as face of metal trim piece at tile edge.

F. **Mirror Mastic:** Buildable synthetic rubber mastic
1. Basis of Design: Gunther Ultra/Bond

G. **Fasteners:** Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, over which mirrored glass units are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance.
   1. Verify compatibility with and suitability of substrates.
   2. Proceed with mirrored glass installation only after unsatisfactory conditions have been corrected and surfaces are dry.

### 3.2 GLAZING

A. **General**: Install mirrored glass units to comply with written instructions of mirrored glass manufacturer and with referenced GANA and NAAMM publications. Mount mirrored glass accurately in place in a manner that avoids distorting reflected images.

B. **Provide space for air circulation** between back of mirrored glass units and face of mounting surface.

C. For wall-mounted mirrored glass units, **install permanent means of support** at bottom and top edges with bottom support designed to withstand mirrored glass weight and top support designed to prevent mirrored glass from coming away from wall along top edges.
   1. **Means of attachment and support** shall be as shown on Drawings or as selected by Architect during shop drawing review.
   2. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrored glass units.
   3. Place a felt or plastic pad between mirrored glass and each clip to prevent spalling of mirrored glass edges.
   4. Apply mirror mounting tape or mirror mastic according to manufacturer's recommendations. Apply mastic in vertical beads only the full length of the mirror, spaced 5-6 inches apart, allowing 3 inches from any edges to begin or end a bead.

### 3.3 PROTECTION AND CLEANING

A. **Protect mirrored glass** from breakage and contaminating substances resulting from construction operations.
   1. Do not permit edges of silvered mirrored glass to be exposed to standing water.
   2. Maintain environmental conditions that will prevent silvered mirrored glass from being exposed to moisture from condensation or other sources for continuous periods of time.

B. **Wash mirrored glass not more than four days before date scheduled for inspections** intended to establish date for Substantial Completion. Wash mirrored glass by methods recommended in NAAMM publication and in writing by mirrored glass manufacturer. Use water and glass cleaners free from substances capable of damaging mirrored glass edges or coatings.

**END OF SECTION**

# SECTION 08 8800

# DECORATIVE GLASS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** interior applications of the following:
   1. Sandblasted glass.

B. **Related Sections** include the following:
   1. **Division 8** Section "**Glazing**" for monolithic and insulating-glass products and glazing requirements.
   2. **Division 8** Section "**Mirrored Glass**" for mirrored glass and glazing requirements.

### 1.3 DEFINITIONS

A. **Deterioration of Laminated Glass**: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's directions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.

### 1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. **General**: Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement and impact loading (where applicable), without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; deterioration of glazing materials; or other defects in construction.

B. **Glass Design**: Glass thicknesses indicated on Drawings are for detailing only. Confirm glass thicknesses by analyzing in-service conditions.

### 1.5 SUBMITTALS

A. **General**: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data** for each glass product and glazing material specified.

C. **Shop Drawings** detailing design and pattern location for each decorative glass unit. Include the following:
   1. **Size** and **location** of penetrations.
   2. Glazing **method**.

D. **Samples for Selection:** 4 inch square (min.) samples of sandblasted glass, showing manufacturer's full range of translucencies and etching depths.

E. **Samples for verification** of the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.
   1. **Decorative Glass**: Manufacturer's standard-size unit, not less than 12 inches (300 mm) square, packaged to prevent breakage. Protect edges of sample.

F. **Product certificates** signed by manufacturers of decorative glass certifying that their products comply with specified requirements.
   1. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality-control program of a recognized certification agency or an independent testing agency acceptable to authorities having jurisdiction.

G. **Sealant compatibility** and adhesion test reports from sealant manufacturer indicating that glazing materials have been tested for compatibility and adhesion with glazing sealants; include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

H. **Maintenance data** for **decorative glass** to include in the operation and maintenance manual specified in Division 1.

## 1.6 QUALITY ASSURANCE

A. **Glazing Publications**: Comply with published recommendations of product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise in this Section or in referenced standards.
   1. **FGMA Publication**: "FGMA Glazing Manual."
   2. **FGMA Publication**: "FGMA Sealant Manual."
   3. **LSGA Publication**: "LSGA Design Guide."

B. **Safety Glass**: Products complying with ANSI Z97.1 and testing requirements of CPSC 16 CFR, Part 1201 for Category I and II materials.
   1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or another certification agency acceptable to authorities having jurisdiction.

C. **Glazier Qualifications**: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

D. **Single-Source Responsibility**: Obtain each type of decorative glass from one source and by a single manufacturer for each product and installation method indicated.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials.

## 1.8 PROJECT CONDITIONS

A. **Field Measurements**: Check actual decorative glass openings by accurate field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating decorative glass without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

B. **Space Enclosure and Environmental Limitations**: Do not install decorative glass until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

# PART 2 - PRODUCTS

## 2.1 PRIMARY FLOAT-GLASS PRODUCTS

A. **Float Glass**: ASTM C 1036, Type I (transparent glass, flat), Class 1 (clear), unless otherwise indicated, and Quality q3 (glazing select).

## 2.2 HEAT-TREATED FLOAT GLASS

A. **Uncoated, Clear, Heat-Treated Float Glass**: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), unless otherwise indicated, Quality q3 (glazing select), kind as indicated below:
   1. Kind HS (heat strengthened) where indicated.
   2. Kind FT (fully tempered) where indicated.

## 2.3 SANDBLASTED GLASS

A. **Sandblasted-Glass Units:** Abrade sandblasted glass evenly, with small particles of sand forced through a high-pressure air nozzle according to manufacturer's standard process.
   1. Antifingerprint Coating: Protective coating, apply as per manufacturer’s recommendation.
   2. Abrade glass to uniform speckle of 100 percent (no vision through) translucency. Architect reserves the right to require a more open translucency based on review of manufacturer-furnished samples.

## 2.4 GLAZING SEALANTS

A. **General**: Provide manufacturer's standard sealant of formulation indicated that is recommended for exposed interior applications, complying with the following requirements:
   1. **Compatibility**: Select glazing sealants of proven compatibility with other materials they will contact, including glass products and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
   2. **Suitability**: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants that are suitable for applications indicated and conditions existing at time of installation.

3. **Colors**: Provide color of exposed joint sealants to comply with the following:
   a. Match colors indicated by referencing manufacturer's standard designations for these characteristics.
   b. Provide Architect's selections from manufacturer's full range of standard colors for products of type indicated.

B. **Latex Sealant**: One-part, nonsag, mildew-resistant, paintable latex sealant complying with ASTM C 834.

## 2.5 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 involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. **Cleaners, Primers, and Sealers**: Type recommended by sealant or gasket manufacturer.

C. **Setting Blocks**: Elastomeric material complying with ASTM C 864 with a Shore A durometer hardness of 85 plus or minus 5.

D. **Spacers**: Elastomeric blocks or continuous extrusions complying with ASTM C 864 with a Shore 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.

## 2.6 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. **Fabricate** decorative glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Minimum required face or edge clearances.

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

## 3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

## 3.3 GLAZING, GENERAL

A. Comply with combined recommendations of manufacturers of glass, sealants, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows:
   1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar.
   2. Remove damaged glass from Project site and legally dispose of off-site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.
   3. Retain below if required.

D. Provide spacers as follows:
   1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances.
   2. Provide not less than 1/8-inch (3-mm) bite of spacers on glass and use thickness equal to sealant width.

E. Set decorative glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

## 3.4 SEALANT GLAZING

A. **Install continuous spacers between glass lites** and glazing stops to maintain glass-face clearance. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. **Force sealants** into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. **Tool** exposed surfaces smooth.

## 3.5 CLEANING AND PROTECTION

A. **Protect glass from breakage** 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 them immediately as recommended by glass manufacturer.

C. **Remove and replace glass that is broken**, chipped, cracked, abraded, or damaged in any way, including by natural causes, accidents, and vandalism, during construction period.

D. **Wash glass on both faces** in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

**END OF SECTION**

# DIVISION 9 - FINISHES


| | |
|---|---|
| Section 09 0000 | Finish Schedule |
| Section 09 2200 | Non-Load-Bearing Steel Framing |
| Section 09 2900 | Gypsum Board |
| Section 09 2910 | Gypsum Sheathing |
| Section 09 3000 | Ceramic Tile |
| Section 09 5100 | Acoustical Tile Ceilings |
| Section 09 6513 | Resilient Floor Tile and Accessories |
| Section 09 6567 | Resilient Athletic Flooring |
| Section 09 6633 | Precast Terrazzo Stair Treads |
| Section 09 6813 | Carpet Tile |
| Section 09 8433 | Acoustical Ceiling Panels |
| Section 09 9100 | Painting |

**WEBER STATE UNIVERSITY STROMBERG ADDITION FINISH SCHEDULE**
**JOB #: 12475**

CCSBA: CUSTOM COLOR SELECTED BY ARCHITECT
SCSBA: STANDARD COLOR SELECTED BY ARCHITECT

| MARK | PRODUCT | MANUFACTURER | DESCRIPTION |
|---|---|---|---|
| | **WALL MATERIALS** | | |
| W1 | GENERAL PAINT | SHERWIN WILLIAMS | SW7012 CREAMY |
| W2 | ACCENT PAINT | SHERWIN WILLIAMS | SW7017 DORIAN GRAY |
| W3 | ACCENT PAINT | SHERWIN WILLIAMS | SW6704 HEP GREEN (GREEN) |
| W4 | ACCENT PAINT | SHERWIN WILLIAMS | SW6982 FULLY PURPLE |
| W5 | ACCENT PAINT | SHERWIN WILLIAMS | CHARCOAL |
| W6 | ACCENT PAINT | SHERWIN WILLIAMS | NOT USED |
| W7 | WALL TILE | MOSA TILES | GLOBAL COLLECTION 16650 (GRAY) |
| W8 | WALL TILE | MOSA TILES | GLOBAL COLLECTION 16860 (BEIGE) |
| W9 | WALL TILE | MOSA TILES | GLOBAL COLLECTION 20930 (PURPLE) |
| W10 | WALL TILE | NOT USED | NOT USED |
| | | | |
| | **FLOOR MATERIALS** | | |
| F1 | GENERAL CARPET | PATCRAFT | 10294 IDEA, COLOR: 00590 MINDSET |
| F2 | ACCENT CARPET | PATCRAFT | 10294 IDEA, COLOR: 00100 INSIGHT |
| F3 | VINYL FLOORING | ARMSTRONG | STRIATIONS BBT, T3608 WARM GRAY |
| F4 | FLOOR TILE | DALTILE | KEYSTONES BLOCK RANDOM; DESERT GRAY SPECKLE D200 |
| F5 | NOT USED | | |
| F6 | RUBBER FLOORING | MONDO | SPORT IMPACT: 011 MEDIUM GREY |
| F7 | RUBBER FLOORING | MONDO | SPORT IMPACT: 018 DARK GREY |
| F8 | RUBBER FLOORING | MONDO | SPORT IMPACT: 026 PURPLE |
| F9 | RUNNING TRACK | MONDO | SUPER X PERFORMANCE: P31 MEDIUM GRAY; WHITE PAINTED STRIPES |
| F10 | ATHLETIC WOOD FLOOR | | NATURAL MAPLE |
| F11 | PORCELAIN TILE | PROVENZA | Q-STONE; GRAY 12X24 |
| F12 | WALK OFF MAT | J&J INVISION | CATWALK 7010; PHOTO OP 1429 |
| F13 | TRAFFIC COATING | CARLISLE | CCW-5013 - SCSBA |
| F14 | SEALED CONCRETE | | CCSBA |
| F15 | VCT | ARMSTRONG | IMPERIAL TEXTURE STANDARD EXCELON 51908 PEWTER |

| | | | |
|---|---|---|---|
| | **WOOD** | | |
| WD1 | WOOD DOORS | VT INDUSTRIES | WHITE MAPLE VENEER, CLEAR FINISH CL07 |
| WD2 | MDF PANELS | (LIGHT STAIN) | CCSBA |
| WD3 | MDF PANELS | (DARK ACCENT STAIN) | CCSBA |

| | | | |
|---|---|---|---|
| | **BASE MATERIAL** | | |
| B1 | RUBBER BASE | JOHNSONITE | 20 CHARCOAL WG |
| B2 | VENTED BASE | | SCSBA |
| B3 | CERAMIC TILE BASE | | |
| B4 | NO BASE- CAULK | | |
| B5 | TRAFFIC COATING | WRAPPED UP 4” ON WALL | SCSBA |
| BE | EXISTING BASE | | |
| | | | |
| | **SURFACE MATERIALS** | | |
| PL1 | PLASTIC LAMINATE | WILSONART | 7949K-18 ASIAN NIGHT (DARK GRAY) |
| PL2 | PLASTIC LAMINATE | WILSONART | 4878-38 PEWTER MESH (LIGHT GRAY) |
| PL3 | PLASTIC LAMINATE | NEVAMAR | VOUS TEMPEST VS6002T (MEDIUM GRAY) |
| PL4 | PLASTIC LAMINATE | NEVAMAR | EXTREME GREEN BAMBOO TEXTURED WZ5001T (GREEN) |
| SS1 | SOLID SURFACE | CAMBRIA | WAVERTON 0250 (WHITE) |
| SS2 | SOLID SURFACE | CAMBRIA | WAVERTON 0250 (WHITE) |
| PLE | EXISTING PLASTIC LAMINATE | | |
| SSE | EXISTING SOLID SURFACE | | |

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# SECTION 09 2100

# GYPSUM BOARD SHAFT-WALL ASSEMBLIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. **Shaft enclosures**.

B. **Related Sections** include the following:
   1. **Division 9 "Gypsum Board Assemblies"** for applying and finishing panels in gypsum board shaft-wall assemblies.

### 1.3 DEFINITIONS

A. **Gypsum Board Construction Terminology**: Refer to ASTM C 11 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

### 1.4 PERFORMANCE REQUIREMENTS

A. **Structural Performance**:
   1. Provide gypsum board shaft-wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.

### 1.5 SUBMITTALS

A. **Product Data**: For each gypsum board shaft-wall assembly indicated.

B. **Fire-Test-Response Reports**: From a qualified independent testing and inspecting agency substantiating each gypsum board shaft-wall assembly's required fire-resistance rating.
   1. Include data substantiating that elevator entrances and other items that penetrate each gypsum board shaft-wall assembly do not negate fire-resistance rating.

C. **Acoustical-Test-Response Reports**: From a qualified independent testing agency substantiating required STC rating for each gypsum board shaft-wall assembly.

## 1.6 QUALITY ASSURANCE

A. **Fire-Resistance-Rated Assemblies**: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory" or GA-600, "Fire Resistance Design Manual."

B. **STC-Rated Assemblies**: For gypsum board shaft-wall assemblies indicated to have STC ratings, provide assembly materials and construction complying with requirements of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

C. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Management and Coordination." Review methods and procedures for installing work related to gypsum board shaft-wall assemblies including, but not limited to, the following:
   1. Fasteners proposed for anchoring steel framing to building structure.
   2. Sprayed fire-resistive materials applied to structural framing.
   3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
   4. Wiring devices in shaft-wall assemblies.
   5. Doors and other items penetrating shaft-wall assemblies.
   6. Items supported by shaft-wall-assembly framing.
   7. Mechanical work enclosed within shaft-wall assemblies.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat on leveled supports off the ground to prevent sagging.

## 1.8 PROJECT CONDITIONS

A. Comply with requirements for environmental conditions, room temperatures, and ventilation specified in Division 9 Section "Gypsum Board Assemblies]."

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Gypsum Co.
   2. G-P Gypsum Corp.
   3. National Gypsum Company.
   4. United States Gypsum Co.

## 2.2 ASSEMBLY MATERIALS

A. **General**: Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
   1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
   2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

B. **Steel Framing**: ASTM C 645.
   1. Protective Coating: Manufacturer's standard corrosion-resistant zinc coating.

C. **Gypsum Liner Panels**: Manufacturer's proprietary liner panels in 1-inch (25.4-mm) thickness and with moisture-resistant paper faces.

D. **Gypsum Wallboard**: ASTM C 36, core type as required by fire-resistance-rated assembly indicated.
   1. Edges: Tapered.

E. **Accessories**: Cornerbead, edge trim, and control joints of material and shapes specified in Division 9 Section "Gypsum Board Assemblies" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.

F. **Gypsum Wallboard Joint-Treatment Materials**: ASTM C 475 and as specified in Division 9 Section "Gypsum Board Assemblies."

G. **Steel Drill Screws**: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

H. **Track (Runner) Fasteners**: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
   1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10 times that imposed by shaft-wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.

I. **Acoustical Sealant**: As specified in Division 7 Section "Joint Sealants."

J. **Sound Attenuation Blankets**: ASTM C 665 for Type I, unfaced mineral-fiber-blanket insulation produced by combining thermosetting resins with mineral fibers manufactured from slag or rock wool.

## 2.3 GYPSUM BOARD SHAFT WALL

A. **Basis-of-Design Product**: As indicated on Drawings by design designation of a qualified testing and inspecting agency.

B. **Sustained Air-Pressure Loads**: 7.5 lbf/sq. ft. (0.24 kPa).

C. **Deflection Limit**: L/240.

D. **Studs**: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.
   1. Depth: Not less than 2-1/2 inches (63.5 mm).
   2. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

E. **Track (Runner)**: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm), in depth matching studs.
   1. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

F. **Jamb Struts**: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76.2 mm), in depth matching studs, and not less than 0.0359 (20 gauge) thick.

G. **Room-Side Finish**: Gypsum board.

H. **Shaft-Side Finish**: As indicated by fire-resistance-rated assembly design designation.

I. **STC Rating**: Minimum 50 STC.

J. **Cavity Insulation**: Sound attenuation blankets.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. **Sprayed Fire-Resistive Materials**: Coordinate with gypsum shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 7 Section "Sprayed Fire-Resistive Materials."
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

## 3.3 INSTALLATION

A. **General**: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
   1. ASTM C 754 for installing steel framing.
   2. Division 9 Section "Gypsum Board Assemblies" for applying and finishing panels.

B. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support.

C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
   1. At elevator hoistway door frames, provide jamb struts on each side of door frame.
   2. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch (0.79-mm) minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 face-layer panel.

D. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.

E. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

F. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

G. Install control joints to maintain fire-resistance rating of assemblies.

H. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

I. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 2 inches (51 mm) of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch- (12.7- or 15.9-mm-) thick, gypsum board cants covering tops of projections.
   1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft-wall framing.
   2. Where steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to the shaft-wall framing.

**END OF SECTION**

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# SECTION 09 2200

# NON-LOAD-BEARING STEEL FRAMING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes non-load-bearing steel framing** members for the following applications:
   1. **Interior framing systems** (e.g., supports for partition walls, framed soffits, furring, etc.).
   2. **Interior suspension systems** (e.g., supports for ceilings, suspended soffits, etc.).

B. **Related Sections** include the following:
   1. **Division 7** Section "**Building Insulation**" for insulation installed in between framing members.
   2. **Division 7** Section "**Fire-Resistive Joint Systems**" for head-of-wall joint systems installed with non-load-bearing steel framing.
   3. **Division 9** Section "**Gypsum Board Shaft-Wall Assemblies**" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated.

### 1.4 QUALITY ASSURANCE

A. **Fire-Test-Response Characteristics**: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. **STC-Rated Assemblies**: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

## PART 2 - PRODUCTS

### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. **Framing Members, General**: Comply with ASTM C 754 for conditions indicated.
   1. **Steel Sheet Components**: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
   2. **Protective Coating**: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating, unless otherwise indicated.

## 2.2 SUSPENSION SYSTEM COMPONENTS

A. **Tie Wire**: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **16 gauge** 0.0625-inch- (1.59-mm-) diameter wire, or double strand of **18 gauge** (0.0475-inch) (1.21-mm-) diameter wire.

B. **Hanger Attachments to Concrete**:
   1. **Powder-Actuated Fasteners**: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. **Wire Hangers**: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

D. **Flat Hangers**: Steel sheet, minimum 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

E. **Carrying Channels**: Cold-rolled, commercial-steel sheet with a base-metal thickness of 16 gauge (0.0538 inch) (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
   1. Depth: Minimum 1-1/2 inches (38 mm).

F. **Furring Channels (Furring Members)**:
   1. **Hat-Shaped, Rigid Furring Channels**: ASTM C 645, 7/8 inch (22.2 mm) deep.
      a. **Minimum Base Metal Thickness**: Minimum **22 gauge** (0.0312 inch) (0.79 mm).
   2. **Resilient Furring Channels**: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
      a. **Equal to**: **RSIC-1** as manufactured by PAC International, Inc.

G. **Grid Suspension System for Ceilings**: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. **Armstrong** World Industries, Inc.; Drywall Grid Systems.
      b. **Chicago** Metallic Corporation.
      c. **USG** Corporation; Drywall Suspension System.

## 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. **Steel Studs and Runners**: ASTM C 645.
   1. **Minimum Base-Metal Thickness**: Minimum 20 **gauge** (30 mil or 0.0312 inch).

B. **Slip-Type Head Joints**:
   1. **Deflection Track**: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      a. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
         1) **Steel Network** Inc. (The); VertiClip SLD/VertiTrack VTD Series.
         2) **Dietrich** Metal Framing, SLP-TRK Slotted Track (BDTK)

C. **Flat Strap and Backing Plate**: Steel sheet for blocking and bracing in length and width indicated.
   1. **Minimum Base-Metal Thickness**: Minimum **16 gauge**.

D. **Cold-Rolled Channel Bridging**: **16 gauge** bare-steel thickness, with minimum 1/2-inch wide flanges.
   1. **Depth**: Minimum 1-1/2 inches .
   2. **Clip Angle**: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), **14 gauge** thick, galvanized steel.

E. **Hat-Shaped, Rigid Furring Channels**: ASTM C 645.
   1. **Minimum Base Metal Thickness**: Minimum **20 Gauge**.
   2. **Depth**: 7/8 inch (22.2 mm).

F. **Resilient Furring Channels**: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
   1. **Equal to**: **RSIC-1** as manufactured by PAC International, Inc.

G. **Cold-Rolled Furring Channels**: **16 gauge** bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
   1. **Depth**: Minimum 3/4 inch (19.1 mm).
   2. **Furring Brackets**: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of **22 gauge**.
   3. **Tie Wire**: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **16 gauge** diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

H. **Z-Shaped Furring**: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of **26 gauge**, and depth required to fit insulation thickness indicated.

## 2.4 AUXILIARY MATERIALS

A. **General**: Provide auxiliary materials that comply with referenced installation standards.
   1. **Fasteners for Metal Framing**: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. **Isolation Strip at Exterior Walls**: Provide the following:
   1. **Sill sealer for exterior steel stud walls**: Provide a sill sealer equal to '**Triple Guard Energy Sill Sealer**' as manufactured by '**Protecto Wrap**'. Seal to have 3/8" thick rubberized adhesive membrane that forms an air/vapor moisture barrier system. The seal shall adhere to the face of the foundation, the top of the foundation wall and the face of the sill plate/skirt board.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine areas and substrates**, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION, GENERAL

A. **Installation Standard**: ASTM C 754.
   1. **Gypsum Board Assemblies**: Also comply with requirements in **ASTM C 840** that apply to framing installation.

B. **Blocking**: Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, cabinets and casework, or similar construction.

C. **Bracing**: Install bracing at terminations in assemblies.

D. **Expansion Joints**: Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

## 3.3 INSTALLING SUSPENSION SYSTEMS

A. **Install suspension system** components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. **Isolate suspension systems** from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. **Suspend hangers from building structure as follows**:
   1. **Install hangers plumb** and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. **Splay hangers only where required** to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. **Where width of ducts** and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. **Size supplemental suspension members** and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. **Wire Hangers**: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. **Flat Hangers**: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to **steel roof deck**.
   6. Do not attach hangers to **permanent metal forms**. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to **rolled-in hanger tabs** of composite steel floor deck.
   8. Do not connect or suspend **steel framing from ducts**, pipes, or conduit.

D. **Fire-Resistance-Rated Assemblies**: Wire tie furring channels to supports.

E. **Seismic Bracing**: Sway-brace suspension systems with hangers used for support.

F. **Grid Suspension Systems**: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. **Installation Tolerances**: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

## 3.4 INSTALLING FRAMED ASSEMBLIES

A. **Where studs are installed directly against exterior masonry walls** or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. **Install studs** so flanges within framing system point in **same direction**.

C. **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 **or** provide **16 gauge studs** at door openings, unless otherwise indicated.
   b. **Install cripple studs** at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. **Extend jamb studs** through suspended ceilings and attach to underside of overhead structure.
3. **Other Framed Openings**: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. **Fire-Resistance-Rated Partitions**: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
5. **Sound-Rated Partitions**: Install framing to comply with sound-rated assembly indicated.
6. **Curved Partitions**:
   a. **Bend track to uniform curve** and locate straight lengths so they are tangent to arcs.
   b. **Begin and end each arc with a stud**, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.
7. **Fasten both flanges of studs to top and bottom tracks**, unless otherwise indicated.

D. **Direct Furring**:

1. Attach to concrete or masonry with stub nails, screws designed for masonry

attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

E. **Z-Furring Members**:

1. **Erect insulation** (specified in Division 7 Section "Building Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
2. **Except at exterior corners**, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
3. **At exterior corners**, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

F. **Tackable Surface**:

1. **Where tackable wall covering/surfacing is scheduled**, provide back to back pairs of studs at 48” o.c., spaced symmetrically from the centerline of the wall. Stud pairs when not coincident with wall framing studs may be terminated and headered 6 inches above the ceiling.

**END OF SECTION**

# SECTION 09 2900

# GYPSUM BOARD

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A.

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

### 1.2 SUMMARY

A. **This Section include**s the following:
1. **Interior** gypsum board.
2. **Glass mat tile backing** panels - **interior**.
3. **Mold-resistant** paper-faced gypsum board.
4. **Aluminum** trim and reveals.
5. **High impact** gypsum board.

B. **Related Sections** include the following:
1. **Division 5** Section "**Cold-Formed Metal Framing**" for load-bearing steel framing that supports gypsum board.
2. **Division 7** Section **"Building Insulation"** for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
3. **Division 7** Section "**Fire-Resistive Joint Systems**" for head-of-wall assemblies that incorporate gypsum board.
4. **Division 7** Section "**Joint Sealants**" for acoustical sealants installed in assemblies that incorporate gypsum board.
5. **Division 9** Section "**Non-Load-Bearing Steel Framing**" for non-structural framing and suspension systems that support gypsum board.
6. **Division 9** Section **"Ceramic Tile"** for cementitious backer units installed as substrates for ceramic tile.
7. **Division 9** painting Sections for **primers** applied to gypsum board surfaces.

### 1.3 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- (300-mm-) long length for each trim accessory indicated.

### 1.4 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. **Mockups:** Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) 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.
   2. Include typical reveals as detailed on Drawings.
   3. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   4. Simulate finished lighting conditions for review of mockups
   5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.5 STORAGE AND HANDLING

A. **Store materials** inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations**: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. **Do not install interior product**s until installation areas are enclosed and conditioned.

C. **Do not install panels** that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

# PART 2 - PRODUCTS

## 2.1 PANELS, GENERAL

A. **Size**: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.2 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. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. **American** Gypsum Co.
      b. **Certainteed** America Inc.
      c. **G-P** Gypsum.
      d. **National** Gypsum Company.

e. **PABCO** Gypsum.
f. **Temple Inland.**
g. **USG** Corporation.

B. **Mold-Resistant** Paper-Faced Products
1. **Mold Resistance**: Score of 10, when tested in accordance with **ASTM D 3273**
2. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. **American** Gypsum; **M-Bloc**.
b. **CertainTeed** Corporation; **ProRoc** Brand **Moisture & Mold** Resistant Gypsum Board.
c. Lafarge North America Inc; Mold Defense Drywall.
d. **National** Gypsum Company; **Gold Bond** Brand XP Gypsum Board.
e. **Pacific Coast** Building Products, Inc; **PABCO Mold Curb** Gypsum Wallboard.
f. **USG** Corporation; Sheetrock Brand **Mold Tough** Gypsum Panels.

C. **Type X:**
1. **Thickness:** 5/8 inch (15.9 mm).
2. **Long Edges**: Tapered.

## 2.3 TILE BACKING PANELS

A. **Glass-Mat,** Water-Resistant Backer Units - **interior**:
1. **Comply** with **ASTM C 1178/C 1178M**.
2. **Available Manufacturers**: Subject to compliance with requirements, available manufacturer's include but are not limited to:
a. "**DensShield Tile Guard**" by **G-P Gypsum**.
b. "**Fiberock Aqua-Tough Interior Panel**" by **USG** Corporation.
3. **Core**: 5/8 inch (15.9 mm), Type X.
4. **Provide glass-mat**, water-resistant backing board **wherever tile is applied to a stud wall.**

## 2.4 HIGH IMPACT PANELS

A. **Impact-Rated Wallboard**: Tested to **Level 3** soft-body and hard-body impact in accordance with **ASTM C 1629**.
1. **Application**: High-traffic areas indicated.
2. **Mold Resistance**: Score of 10, when tested in accordance with ASTM D 3273.
3. **Paper-Faced Type**: Gypsum wallboard as defined in ASTM C 1396/C 1396M.
4. **Unfaced Type**: Interior fiber-reinforced gypsum panels as defined in ASTM C 1278/C 1278M.
5. **Type**: Fire-resistance rated Type X, UL or WH listed.
6. **Thickness**: 5/8 inch (16 mm).
7. **Edges**: Tapered.
8. **Available Products**:
a. **National** Gypsum Company; **Gold Bond Hi-Impact** Brand XP Wallboard.
b. **USG** Corporation; Fiberock Brand Panels--**VHI Abuse-Resistant**.

## 2.5 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. **L-Bead**: L-shaped; exposed long flange receives joint compound.
      e. **U-Bead**: J-shaped; exposed short flange does not receive joint compound.
      f. **Expansion** (control) joint.
      g. **Curved-Edge Cornerbead**: With notched or flexible flanges.
   3. **Material: Vinyl** conform to ASTM D-1784.
      a. **Available Manufacturers** include but are not limited to:
         **AMICO** (Alabama Metal Industries corporation)
         Birmingham, AL 35208 Tel: 1-800-366-2642 Fax: 205-780-3303
         www.amico-lath.com
   4. **Shapes**:
      a. **Zip Strip** Bead.

B. **Aluminum Trim and Reveals:** Extruded accessories of profiles and dimensions indicated.
   1. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      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 B 221 (ASTM B 221M), Alloy 6063-T5.
   3. **Finish:** Clear Anodized.
   4. Where indicated on Drawings, **provide a horizontal aluminum reveal** equal to Fry Integrated Functional Gypsum Board Reveal Rail (model 935).
      a. 3-3/4 inches overall height, with 2 inch backpiece. Designed for 5/8 inch gypsum board.
      b. Furnish complete with coordinating chartrail inserts (2-1/4 inch deep x 18 inches long) and hook inserts (1 inch wide with 9/16 inch high lip).
         1) Provide one (1) chartrail per wall with presentation wall coverings.
         2) Provide four (4) hook inserts per wall with presentation wall coverings.
      c. Inserts shall have rubber gasket to protect walls.
   5. Where indicated on Drawings, **provide a vertical aluminum reveal** equal to Fry 5/8 D inch x 1/2 H inch, model DRM-625-50
   6. Where reveals in wall plane intersect, **provide factory fabricated intersection pieces**, including inside corners and cross intersections. Legs of fabricated pieces shall be a minimum of 6 inches long; provide connector clips where intersection pieces about running trim.
   7. **Intersecting reveals of different types shall have the same size reveal opening**. Openings shall neatly and precisely align.

## 2.6 JOINT TREATMENT MATERIALS

A. **General:** Comply with ASTM C 475/C 475M.

B. **Joint Tape**:
   1. **Interior Gypsum Wallboard**: Paper.
      a. Toxicity/IEQ: Fiberglass joint tape not permitted.
   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. **Toxicity/IEQ:** Lime compound. All purpose joint and texturing compound containing inert fillers and natural binders. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.
   2. **Prefilling:** At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   3. **Embedding and First Coat**: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   4. **Fill Coat:** For second coat, use drying-type, all-purpose compound.
   5. **Finish Coat:** For third coat, use drying-type, all-purpose compound.

D. **Joint Compound for Tile Backing Panels**:
   1. **Glass-Mat, Water-Resistant Backing Panel**: As recommended by backing panel manufacturer.

## 2.7 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 (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. **Acoustical Sealant:** As specified in **Division 7** Section "**Joint Sealants**."

E. **Thermal Insulation:** As specified in **Division 7** Section "**Building Insulation**."

F. **Vapor Retarder:** As specified in **Division 7** Section "**Building Insulation**."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine areas and substrates**, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. **Examine panels before installation**. Reject panels that are wet, moisture damaged, and mold damaged.

C. **Proceed with installation** only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

A. **Comply** with **ASTM C 840**.

B. **Install ceiling panels** across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. **Install panels with face side out.** Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. **Locate edge** and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. **Form control and expansion joints** with space between edges of adjoining gypsum panels.

F. **Cover both faces** of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. **Isolate perimeter** of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. **Attachment to Steel Framing**: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

## 3.3 APPLYING INTERIOR GYPSUM BOARD

A. **Install interior gypsum board** in the following locations:
   1. **Type X:** Vertical surfaces, unless otherwise indicated.

B. **Single-Layer Application:**
   1. **On ceilings**, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
   2. **On partitions/walls,** apply gypsum panels **horizontally** (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. **Stagger abutting end joints** not less than one framing member in alternate courses of panels.
      b. **At stairwells** and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
   3. **On Z-furring members**, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. **Fastening Methods**: Apply gypsum panels to supports with steel drill screws.

C. **Multilayer Application:**
   1. **On ceilings,** apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
   2. **On partitions/walls**, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
   3. **On Z-furring members,** apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
   4. **Fastening Methods:** Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

D. **Laminating to Substrate**: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. **Curved Surfaces:**
   1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
   2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

## 3.4 APPLYING TILE BACKING PANELS

A. **Glass-Mat,** Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. **Where tile backing panels abut other types of panels** in same plane, shim surfaces to produce a uniform plane across panel surfaces.

## 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. **All exposed panel edges**, regardless of location, shall be trimmed and finished.

C. **Control Joints:** Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

D. **Interior Trim**: Install in the following locations:
1. **Cornerbead:** Use at outside corners, unless otherwise indicated.
2. **Bullnose Bead**: Use where indicated.
3. **LC-Bead**: Use at exposed panel edges.
4. **L-Bead**: Use where indicated.
5. **U-Bead**: Use at exposed panel edges.
6. **Curved-Edge Cornerbead:** Use at curved openings.

E. **Aluminum Trim:** Install in locations indicated on Drawings. Align reveals.

F. **Install corner beads** at external corners. Provide metal trim to protect edge of gypsum board wherever gypsum board intersects a dissimilar material. Hold channel and L trim back from metal window and door frames 1/8 inch to allow for caulking.

G. **Integrated Functional Reveal:** Apply gypsum tape and compound to provide a smooth transition to wall surface.

## 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**, rounded or 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**: Concealed areas, and where indicated.
   2. **Level 2**: Panels that are substrate for tile.
   3. **Level 3**: Panels that are substrates for wall coverings and wall panels and in mechanical plenums and spaces above ceilings used for air movement. Plenums and similar spaces shall receive a coat of primer.
   4. **Level 4**: At panel surfaces that will be exposed to view, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other **Division 9** Sections.
   5. **Level 5:** In areas with oblique lighting such as corridors with a window at the end, lobby walls that end at windows. Also, on walls to receive deep tone paints or paints with a gloss level higher than "flat".
      a. Primer and its application to surfaces are specified in other **Division 9** Sections.
      b.

E. **Glass-Mat, Water-Resistant Backing Panels**: Finish according to manufacturer's written instructions where exposed to view.

## 3.7 PROTECTION

A. **Protect installed products** from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. **Remove and replace** panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## 3.8 FIELD QUALITY CONTROL

A. **Above-Ceiling Observation:** Architect will conduct an above-ceiling observation before installing gypsum board ceilings and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. **Notify Architect** seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
   2. **Before notifying Architect,** complete the following in areas to receive gypsum board ceilings:
      a. Installation of 80 percent of lighting fixtures, powered for operation.
      b. Installation, insulation, and leak and pressure testing of water piping systems.
      c. Installation of air-duct systems.
      d. Installation of air devices.
      e. Installation of mechanical system control-air tubing.
      f. Installation of ceiling support framing.

**END OF SECTION**

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# SECTION 09 2910

# GYPSUM SHEATHING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. **Glass-mat** gypsum sheathing board.

B. **Related Sections** include the following:
   1. **Division 5** Section "**Cold-Formed Metal Framing"** for steel framing.
   2. **Division 7** Section "**Sheet Metal Flashing and Trim"** for flashing installed with gypsum sheathing.
   3. **Division 7** Section "**Joint Sealants"** for sealants applied with gypsum sheathing.
   4. **Division 7** Section "**Fluid-Applied Air, Water, and Vapor Barriers**" for barrier system applied over sheathing, including joint treatment.
   5. **Division 9** Section "**Gypsum Board"** for interior gypsum panels incorporated into assemblies with gypsum sheathing on the exterior.

### 1.3 DEFINITIONS

A. **Gypsum Board Construction Terminology Standard**: Refer to ASTM C 11 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated.
   1. **Building Wrap**: For air/moisture-infiltration protection, include data substantiating compliance with building code in effect for Project.

### 1.5 QUALITY ASSURANCE

A. **Fire-Test-Response Characteristics**: For assembles with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. **Fire-Resistance Ratings**: Indicated by design designations from UL's "Fire Resistance Directory.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. **Store materials** protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

B. **Cementitious backer units**: Materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.
   1. **WARNING**: Store all cementitious backer units **flat**. **Panels are heavy** and can fall over, causing **serious injury or death**. Do not move unless authorized.

## 1.7 COORDINATION

A. **Glass-Mat Gypsum Sheathing Board**:
   1. Do not leave exposed to weather for more than 180 days.

# PART 2 - PRODUCTS

## 2.1 GYPSUM SHEATHING

A. **Glass-Mat Gypsum Sheathing Board**: ASTM C 1177/C 1177M.
   1. **Available Manufacturers**: Subject to compliance with requirements, manufacturers include but are not limited to:
      a. "**Dens-Glass Gold**" by **G-P** Gypsum Corporation.
      b. "**GlasRoc**" by **CertainTeed** Inc.
      c. "**Securock Glass-Mat Sheathing**" by **USG**.
   2. **Type and Thickness**: Type X, 5/8 inch (15.9 mm) thick.
   3. **Size**: Not less than 48 by 96 inches (1219 by 2438 mm) for vertical installation.

## 2.2 ACCESSORY MATERIALS

A. **Fasteners**: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
   1. For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing with steel drill screws complying with ASTM C 1002.
   2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

# PART 3 - EXECUTION

## 3.1 GYPSUM SHEATHING INSTALLATION

A. **Comply** with **GA-253** and manufacturer's written instructions.

B. **Cut boards at penetrations**, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
   1. Install boards with a 3/8-inch (9-mm) setback where non-load-bearing construction abuts structural elements.
   2. Install boards with a 1/4-inch (6.4-mm) setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.

C. **Coordinate 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 exterior wall assembly.

D. **Apply fasteners** so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. **Do not bridge building expansion joints** with sheathing; cut and space edges to match spacing of structural support elements.

F. **Installation:** Install board with edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud.

1. **Space fasteners** approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9 mm) from edges and ends of boards.

**END OF SECTION**

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# SECTION 09 3000

# CERAMIC TILE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. **Unglazed ceramic mosaic** tile.
2. **Porcelain** floor and wall tile.
3. **Thresholds** installed as part of tile installations.

B. **Related Sections** include the following:
1. **Division 3** Section "**Cast-in-Place Concrete**" for monolithic slab finishes specified for tile substrates.
2. **Division 7** Section "**Joint Sealants**" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. **Division 9** Section "**Finish Schedule**" for product selections and colors.
4. **Division 9** Section "**Gypsum Board**" for tile backing panels installed in gypsum wallboard assemblies.

### 1.3 DEFINITIONS

A. **Module Size**: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. **Facial Dimension**: Nominal tile size as defined in ANSI A137.1.

C. **Movement Joints**: Include the following types of joints: Cold Joint, Construction Joint, Contraction Joint, Control Joint, Expansion Joint and Isolation Joint.

### 1.4 PERFORMANCE REQUIREMENTS

A. **Static Coefficient of Friction**: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. **Level Surfaces**: Minimum 0.6.

B. **Load-Bearing Performance**: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
1. **Heavy:** Passes cycles 1 through 12.

### 1.5 SUBMITTALS

A. **Product Data**: For each type of tile, mortar, grout, and other products specified.

B. **Shop Drawings**: Submit shop drawings showing location of each tile and installation method. Include movement joint locations, trim type and size.

C. **Tile Samples for Selection**: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

D. **Grout Samples for Selection**: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

## 1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. **Source Limitations for Tile**: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. **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.

D. **Source Limitations for Other Products**: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
1. Solid Surface Material thresholds.
2. Waterproofing.

E. **Movement Joints**: Provide movement joints as recommended by **TCNA EJ171-09** "Movement Joint Design Essentials". Space joints as recommended by TCNA method, **coordinate with the Architect** for **precise location** of joints.
1. **Align** with any **cold joints** or other **movement joints** provided by other trades.
2. **Interior Joints**: 20 to 25 feet in each direction.
3. **Interior Joints exposed to direct sunlight or moisture**: 8 to 12 feet in each direction.
4. **Perimeter Joint**: Where tile abuts restraining surfaces such as perimeter walls, columns, stairs and curbs.

## 1.7 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 of ANSI A137.1 for labeling sealed tile packages.

B. **Prevent damage** or contamination to materials by water, freezing, foreign matter, and other causes.

C. **Handle tile** with 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.

## 1.8 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

## 1.9 EXTRA MATERIALS

A. **Deliver extra materials to Owner**. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. **Tile and Trim Units**: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

# PART 2 - PRODUCTS

## 2.1 PORCELAIN TILE MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Wall Tile:**
      a. **Manufacturer:** Mosa.
      b. **Product:** Global Collection
   2. **Floor Tile:**
      a. **Manufacturer**: Provenza by Emilceramica S.p.A
      b. **Product:** Q-Stone.

B. **Substitutions:** Submit products other than the "Basis of Design" as a substitution, according to Conditions of the Contract and Division 1 Sections.

## 2.2 CERAMIC MOSAIC MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other available manufacturers with products having equivalent characteristics may be considered provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Daltile Corporation
   2. **Product:** Keystones.

B. **Available Manufacturers**: Subject to compliance with requirements (including color and texture as indicated in Finish Schedule), manufacturers offering products that may be incorporated into the Work include the following:
   1. **American Olean** Tile Company.
   2. **Daltile** Corporation.
   3. **United States Ceramic** Tile Company.

## 2.3 TILE-SETTING AND -GROUTING MATERIALS

A. **Available Manufacturers**: Subject to compliance with requirements (including color and texture as indicated in Finish Schedule), manufacturers offering products that may be incorporated into the Work include the following:
   1. **Custom** Building Products
   2. **Laticrete** International, Inc.
   3. **Mapei** Corporation.

## 2.4 PRODUCTS, GENERAL

A. **ANSI Ceramic Tile Standard**: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. **Provide tile** complying with **Standard Grade** requirements, unless otherwise indicated.
   2. **For facial dimensions of tile**, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. **ANSI Standards for Tile Installation Materials**: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. **Colors, Textures, and Patterns**: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
   1. **Provide products indicated in the Finish Schedule.**
   2. Where a Finish Schedule is not provided or does not indicate a specific product, **provide selections** from manufacturer's full range of colors, textures, and patterns for products of type indicated.
   3. **Provide tile trim and accessories** that match color and finish of adjoining flat tile.

D. **Factory Blending**: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

E. **Mounting**: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.
   1. **Where tile** is indicated for installation in **wet areas**, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

F. **Factory-Applied Temporary Protective Coating**: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.5 TILE PRODUCTS

A. **Unglazed Ceramic Mosaic Tile**: Provide factory-mounted flat tile complying with the following requirements:
   1. **Composition**: Porcelain.
   2. **Module Size:** Block random (mix of 1 x 1, 1 x 2, and 2 x 2 tiles).
   3. **Nominal Thickness**: 1/4 inch (6.35 mm).
   4. **Face**: Plain with cushion edges.
   5. **Colors**: As listed in the **Finish Schedule** or if not indicated then as selected by the Architect from Price Group II.
   6. **Accents**: Provide 15% of surface as accent bands and patterns selected by Architect from Price Group IV or V.

B. **Porcelain Ceramic Floor Tile**: Provide factory-mounted flat tile complying with the following requirements:
   1. **Composition**: Porcelain.
   2. **Module Size (nom.)**: 12 x 24 inches (300 mm x 600 mm).
   3. **Nominal Thickness**: 5/16 inch (8 mm).
   4. **Face**: Matte finish with square edges; "naturale".
   5. **Colors**: As listed in the **Finish Schedule** or if not listed then as selected by Architect from manufacturer's full range.

C. **Porcelain Wall Tile**: Provide flat tile complying with the following requirements:
   1. **Composition**: Glazed Porcelain.
   2. **Module Size**: 6 x 6 inches (150 mm x 150 mm).
   3. **Nominal Thickness**: 5/16 inch (8 mm).
   4. **Face**: Plain with square or cushion edges.
   5. **Surface**: Plain gloss.
   6. **Color:** As listed in the **Finish Schedule** and as shown on drawings. If not indicated then as selected by the Architect from series indicated.

D. **Trim Units**: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
   1. **Size**: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
   2. **Shapes**: As follows, selected from manufacturer's standard shapes:
      a. **Base for Portland Cement Mortar Installations**: Coved, flush.
      b. **Base for Thin-Set Mortar Installations**: Straight.
      c. **Wainscot Cap for Thin-Set Mortar Installations**: Surface bullnose.
      d. **External Corners for Thin-Set Mortar Installations**: Surface bullnose.
      e. **Internal Corners**: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

## 2.6 FLUID APPLIED WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. **Use at wet areas** such as locker rooms, showers, toilet rooms, etc.

B. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
   1. **Mer-Krete Hydro-Guard 2000** a Division of Parexlaharba.
      a. Provide a **Type II synthetic reinforcement** cloth.

2. **Fluid applied membrane** to have the following properties:
   a. **The membrane** shall elongate a minimum of **500%**.
   b. **The membrane** shall withstand a water head of **115 ft**. for a period of sixty minutes without water transmission or rupture of the membrane.
   c. **The minimum thickness** of the membrane shall be **30 mils**.
   d. **Elongation** over crack **0.22 inches** (Split Slab Test).
   e. **Adhesion** in shear 250 psi or greater.
   f. **Tensile** 450 psi
   g. **Tile Adhesion to membrane**: equal to Mer-Krete Latex 200, or Mer-Krete 710 Series Thinset Mortars (ANSI A118.4) method in excess of 500 psi
   h. **Freeze Thaw cycle** after cure - 250 cycles. No Change (M/K A-223 ) method.
   i. **Membrane** shall be ICBO Listed and meet **ANSI A-118.10** Standard.
   j. **Joint Backing**: closed cell polyethylene.
   k. **Sealant**: Single or two component urethane per TCNA requirements.

## 2.7 METAL JOINT TRIM

A. **Acceptable Manufacturer:** Subject to compliance with requirements of Contract Documents, provided products by manufacturer listed below. If not listed, submit as substitution according to Conditions of the Contract and the provisions of Division 1 Sections.
   1. **Schluter Systems**; www.schluter.com.

B. **Finish:** Satin nickel anodized aluminum.

C. **Shapes:** As indicated in Finish Schedule and below:
   1. Field Movement Joint: DILEX-BWS
   2. Perimeter Movement Joint: DILEX-BWA
   3. Tile Transition edge: RENO series.

## 2.8 THRESHOLDS

A. **General**: Provide thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
   1. **Bevel edges** at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. **Limit height of threshold to 1/2 inch (12.7 mm) or less** above adjacent floor surface.

B. **Marble Thresholds**: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.
   1. **Description**: Uniform, fine- to medium-grained white stone with gray veining.

## 2.9 SETTING MATERIALS

A. **Latex-Portland Cement Mortar:** ANSI **A118.4**, composed as follows:

1. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:
   a. **Basis of Design** : **Laticrete 3701** or **Mapei Kerabond/Keralastic**.
   b. **Latex Additive**: Styrene butadiene rubber.
   c. **For wall applications**, provide nonsagging, latex-Portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.
   d. **Protection:**
      1) **Install** only at temperatures **between 40 deg. f. and 95 deg. F**.
      2) **Protect from traffic for 24 hours**. Protect from **heavy traffic** for **7 days**.
      3) **Protect from frost and rain for 21 days**.
      4) **Protect from water immersion for 21 days.**

## 2.10 GROUTING MATERIALS

A. **Latex-Portland Cement Grout**: ANSI A118.6 for materials described in Section H-2.4, composed as follows:

1. **Mixture of Dry-Grout Mix and Latex Additive**: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:
   a. **Unsanded Dry-Grout Mix**: Dry-set grout complying with ANSI A118.6 and ISO **CG2WA** (cementitious grout (CG), improved (2), with reduced water absorption (W) and high abrasion resistance (A)) , **for joints 1/8 inch (3.2 mm) and narrower**.
      1) **Basis of Design**: Mapei "Keracolor U".
      2) **Stain Resistant Additive**: Mapei "Grout Maximizer" in lieu of water as recommended by manufacturer.
      3) **Protection:**
         (a) **Use only** at temperatures **between 50 deg. F and 100 deg. F**.
         (b) At **showers and tub surrounds**, **restrict use for 48 hours**; at **steam showers**, restrict use for **14 days**.
         (c) **Keep** installation **from immersion** in water and protect from rain and freezing for **at least 21 days** after completion.
         (d) **Floors**: Keep free from heavy traffic for at least 3 hours after grouting.
         (e) **Walls**: Protect from impact, vibration, and hammering on adjacent and opposite walls for 14 days after tile installation.
         (f) **Allow for extended periods of cure and protection** when temperatures drop below 60 deg. F or when the relative humidity is higher than 70 percent.

b. **Sanded Dry-Grout Mix**: Commercial Portland cement grout complying with ANSI A118.6 and ISO **CG2WA** (cementitious grout (CG), improved (2), with reduced water absorption (W) and high abrasion resistance (A)), **for joints 1/8 inch (3.2 mm) and wider**.
   1) **Basis of Design**: Mapei "Keracolor S".
   2) **Stain Resistant Additive**: "Grout Maximizer" in lieu of water (or as recommended by grout manufacturer).
   3) **Protection:**
      (a) **Use only** at temperatures **between 50 deg. F and 100 deg. F**.
      (b) At **showers and tub surrounds**, **restrict use for 48 hours**; at **steam showers**, restrict use for **14 days**.
      (c) **Keep** installation **from immersion** in water and protect from rain and freezing for **at least 21 days** after completion.
      (d) **Floors**: Keep free from heavy traffic for at least 3 hours after grouting.
      (e) **Walls**: Protect from impact, vibration, and hammering on adjacent and opposite walls for 14 days after tile installation.
      (f) **Allow for extended periods of cure and protection** when temperatures drop below 60 deg. F or when the relative humidity is higher than 70 percent.

c. **Colors**: As selected by Architect from manufacturer's full range of colors.

## 2.11 ELASTOMERIC SEALANTS

A. **General**: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."

B. **Colors**: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. **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 temperature extremes.

D. **Multipart, Pourable Urethane Sealant for Use T**: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

E. **Available Products**: Subject to compliance with requirements, products which may be incorporated into the Work include, but are not limited to, the following:
   1. **One-Part, Mildew-Resistant Silicone Sealants**:
      a. Dow Corning 786; Dow Corning Corporation.
      b. Sanitary 1700; GE Silicones.
      c. Pecora 898 Sanitary Silicone Sealant; Pecora Corp.
      d. Tremsil 600 White; Tremco, Inc.

2. **Multipart, Pourable Urethane Sealants**:
   a. Chem-Calk 550; Bostik.
   b. Vulkem 245; Mameco International, Inc.
   c. NR-200 Urexpan; Pecora Corp.
   d. THC-900; Tremco, Inc.

## 2.12 MISCELLANEOUS MATERIALS

A. **Trowelable Underlayments and Patching Compounds**: Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. **Metal Edge Strips**: White-zinc-alloy terrazzo strips, 1/8 inch (3.2 mm) wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.

C. **Temporary Protective Coating**: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.
   1. **Petroleum paraffin wax**, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.

D. **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.

E. **Grout Sealer**: Solvent-based, no-sheen, natural-look penetrating sealer for all sanded and non-sanded grout joints.
   1. Equal to: **AQUA MIX,** Inc., Sealers Choice.

## 2.13 MIXING MORTARS AND GROUT

A. **Mix mortars** and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. **Add materials and additives in accurate proportions**. Do not use or add any water to mortar or grout when mixing, use only latex additive.

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 from 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 latter in consultation with Architect.

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

### 3.2 PREPARATION

A. **Remove coatings**, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. **Provide concrete substrates** for tile floors installed with dry-set or latex-Portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
   1. **Use trowelable leveling and patching compounds** per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
   2. **Remove protrusions**, bumps, and ridges by sanding or grinding.

C. **Blending**: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in 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.

D. **Field-Applied Temporary Protective Coating**: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:
   1. **Petroleum paraffin wax**, applied hot.

### 3.3 INSTALLATION, GENERAL

A. **ANSI Tile Installation Standards**: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. **TCNA Installation Guidelines**: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.

C. **Extend tile work into recesses** and under or behind equipment and fixtures to form a 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 the 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.
1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. **Lay out tile wainscots** to next full tile beyond dimensions indicated.

G. **Movement Joints**: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated or if not indicated as recommended by **TCNA guidelines**, 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. Locate joints as indicated on Drawings or, if not indicated, in accordance with the following spacings:

| Environment | Minimum | Maximum | Joint Width |
|---|---|---|---|
| Interior | 16 feet | 20 feet | 1/4 inch |
| Interior/Sunlight | 8 feet | 12 feet | 1/4 inch |

3. **Prepare joints** and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

H. **Grout tile to comply** with the 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.

## 3.4 FLOOR TILE INSTALLATION

A. **General**: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing **TCNA** installation methods and **ANSI A108** series of tile installation standards.
1. **Installation Methods**:
   a. **Tile over Concrete** Surfaces in **Shower Areas**: **TCNA F122-11**.
      1) **Waterproof membrane** meeting **ANSI A118.10**.
      2) **Mortar** meeting **ANSI A108.1A**.
   b. **Tile over Concrete** Surfaces: **TCNA F125A-11**.

B. **Joint Widths**: Install tile on floors with the following joint widths:
1. **Porcelain Mosaic Tile**: 1/8 inch.
2. **Ceramic Mosaic Tile**: 1/16 inch.
3. **Ceramic Tile**: 1/16 inch.

C. **Back Buttering**: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
   1. Tile floors composed of tiles 8 by 8 inches (203 by 203 mm) or larger.
   2. Tile floors installed with chemical-resistant grouts.

D. **Solid Surface Thresholds**: Install solid surface thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
   1. Set thresholds in latex-Portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

E. **Metal Edge Strips**: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

F. **Apply two (2) coats of grout sealer** in accordance with manufacturer's printed instructions and recommendations. Remove sealer remaining on the tile within 3 to 5 minutes of application.

## 3.5 WALL TILE INSTALLATION

A. **Install** types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCNA installation methods and ANSI setting-bed standards.
   1. **Installation Methods**:
      a. **Tile over Masonry** Surfaces: **TCNA W211-11**
      b. **Tile over glass mat** tile backer panels - Interior Surfaces: **TCNA W244C-11**
      c. **Tile for Showers**: **TCNA B431-11**.

B. **Joint Widths**: Install tile on walls with the following joint widths:
   1. **Ceramic Tile**: 1/16 inch (1.6 mm).
   2. **Wall Tile**: 1/16 inch (1.6 mm).

C. **Back Buttering**: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
   1. Tile wall installations in wet areas, including showers.
   2. Tile wall installations composed of tiles 8 by 8 inches (203 by 203 mm) or larger.

D. **Apply two (2) coats of grout sealer** in accordance with manufacturer's printed instructions and recommendations. Remove sealer remaining on the tile within 3 to 5 minutes of application.

## 3.6 CLEANING AND PROTECTING

A. **Cleaning**: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. **Remove latex-Portland cement grout residue** from tile as soon as possible.
   2. **Unglazed tile** may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

3. **Remove temporary protective coating** by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. **Finished Tile Work**: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. **Provide final protection** and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

D. **When recommended by tile manufacturer**, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

E. **Prohibit foot and wheel traffic** from tiled floors for at least 7 days after grouting is completed.

F. **Before final inspection**, remove protective coverings and rinse neutral cleaner from tile surfaces.

**END OF SECTION**

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# SECTION 09 5100

# ACOUSTICAL CEILINGS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. **Section includes** acoustical ceiling tile, suspension system and accessories.

B. **Related Documents**: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

### 1.2 SUBMITTALS

A. **Product Data**: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.
   1. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performances.

B. **Samples**: Set of 6 inch x 4 inch square samples for each acoustical unit required, showing full range of exposed color and texture to be expected in completed work.
   1. Set of 12 inch long samples of each exposed runner and molding.

### 1.3 QUALITY ASSURANCE

A. **Source Limitations**:
   1. **Acoustical Ceiling Panel**: Obtain each type through one source from a single manufacturer.
   2. **Suspension System**: Obtain each type through one source from a single manufacturer.

B. **Fire Performance Characteristics**: Provide acoustical ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate marking of applicable testing and inspecting agency.
   1. **Surface Burning Characteristics**: As follows, tested per ASTM E 84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 50 or less.
   2. **Fire Resistance Ratings**: As indicated by reference to design designation in UL "Fire Resistance Directory" or "FM Approval Guide", for floor, roof or beam assemblies in which acoustical ceilings function as a fire protective membrane; tested per ASTM E 119. Provide protection materials for lighting fixtures and air ducts to comply with requirements indicated for rated assembly.

C. **Seismic Standard**: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
   1. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."

D. **Coordination of Work**: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

## 1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

## 1.5 PROJECT CONDITIONS

A. **Space Enclosure**: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy

## 1.6 COORDINATION

A. **Coordinate layout and installation** of acoustical panels 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

## 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. **Acoustical Ceiling Panels**: Full-size equal to 2.0 percent of quantity installed.
   2. **Suspension System Components**: Quantity of each exposed component equal to 2.0 percent of quantity installed.
   3. **Hold-Down Clips**: Equal to 2.0 percent of amount installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following

1. **Suspension System**:
   a. **Armstrong**.
   b. **Chicago Metallic** Corp.
   c. **Donn** Corp.
   d. **National Rolling Mills**, Inc.
2. **Acoustical Tile**:
   a. **Armstrong**.
   b. **Certainteed**.
   c. **USG**.
3. **Acoustical Sealant**:
   a. **Tremco Acoustical Sealant**; Tremco.
   b. **USG Acoustical Sealant**; United States Gypsum Co.
   c. **Chem-Calk 600**; Woodmont Products, Inc.
   d. **Pecora** Corp; **AC 20 FTR** Acoustical and Insulation Sealant

### 2.2 MATERIALS

A. **Acoustical Ceiling Units**:

1. **General**: Provide manufacturer's standard units of configuration indicated which are prepared for mounting method designated and which comply with FS SS-S-118 requirements, including those indicated by reference to type, form, pattern, grade (NRC or NIC's as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).
2. **Mounting Method for Measuring NRC**: No. 7 (mechanically mounted on special metal support), FS SS-S-118; or Type E-400 mounting as per ASTM E 795.
3. **Sound Attenuation Performance**: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1-II "Ceiling Sound Transmission Test by Two-Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).

B. **Ceiling Types**:

**Type 'A'** Ceiling

**Armstrong**: **'Ultima' Tegular** High Washability Lay-In (1937)
**Size:** 24 x 24 x 3/4 inch
**Edge**: Beveled Tegular Lay-in.
**CAC**: 35
**LR**: 0.86
**NRC:** 0.70
**Recycled Content**: Up to 80 percent
**ASTM E1264 Classification:** Type IV, Form 2, Pattern E
**Surface Finish:** Factory-applied latex paint on acoustically transparent water-repellent membrane.
**Color**: **White**.

**OR equivalent:** Certainteed or USG.

**Type 'B'** Ceiling

**Armstrong: 'Cortega' Square** Lay-In (769) **or 'Random Texture'** (933)

**Size**: 24 x 48 x 5/8 inch
**Edge:** Square Lay-in.
**CAC**: 35
**LR:** 0.82
**NRC**: 0.55
**Recycled Content:** Up to 43 percent
**ASTM E1264 Classification:** Type III, Form 2, Pattern C D.
**Surface Finish:** Factory-applied latex paint
**Color:** White.

**Type 'C'** Ceiling

**Gypsum Board** - See Division 9 Sections "Non-Load-Bearing Steel Framing" and "Gypsum Board".

**Type 'D'** Ceiling

**USG: "Geometrix",** lay-in aluminum panels.

**Panel Profile:** Wedge
**Panel Size:** 24 x 24 inches; depths vary.
**Panel Features:** Perforated (Pattern C375) with manufacturer's standard factory installed black acoustical liner ("Acoustibond").
**Color:** Silver Satin. (Grid to match).
**Overall Installation Pattern:** "Pinwheel".
**Furnish complete** with pre-engineered utility circles for integration of lights and services. Coordinate with Division 21, 22, 23, and 26 contractors.
**Notes:**

(a) As part of approval process, furnish digital rendering of ceiling system, modeled in space where scheduled.
(b) Upon request, furnish a mockup of ceiling system, showing enough of the "Pinwheel" pattern to illustrate the overall effect of the ceiling system.
(c) Contractor may propose alternate products of comparable style. Provide manufacturer's catalog showing options as part of substitution review process.

1. **Type 'E'** Ceiling
   a. Open to structure above, painted color as selected by Architect.
2. **Type 'F'** Ceiling
   a. **Metal Soffit** - See Division 7 Section "Metal Soffit Panels"
3. **Type 'G'** Ceiling
   a. **2 Hour Rated Gypsum Board** - See Division 9 Sections "Non-Load-Bearing Steel Framing" and "Gypsum Board".
4. **Types 'H' and 'I'** Ceilings - **NOT USED**
5. **Type 'J'** Ceiling
   a. **Aluminum Composite Panels** - See Division 7 Section "Composite Metal Wall Panels".
6. **Type 'X'** Ceiling
   a. Existing ceiling to remain. Repair ceilings damaged by construction - replace all acoustical panels in a single space.

C. **Metal Suspension System**: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C 635 requirements.

1. **Finishes and Colors**: Provide manufacturer's standard finish for type of system indicated, unless otherwise required. For exposed suspension members and accessories with painted finish, provide color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's full range of standard colors.
2. **Attachment Devices**: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung.
3. **Hanger Wire**: Galvanized carbon steel wire, ASTM A 641, soft temper, pre-stretched, Class 1 coating, sized so that stress at 3- times hanger design loan (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.
4. **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 panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
   a. **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.
   b. **For circular penetrations of ceiling,** provide edge moldings fabricated to diameter required to fit penetration exactly.
   c. **Provide shadow reveal molding** with width of reveal equal to depth of reveal.
   d. Colors of Moldings and Trims: As selected by Architect.
5. **Hold-Down Clips**: Minimum 24 gauge spring steel, 1-7/16 inches deep x 7/8 inches wide, designed to fit over cross tees. Provide clips spaced symmetrically 2 ft. o.c.
6. **Seismic Struts**: Manufacturer's standard compression struts designed to accommodate seismic forces. Struts will be required at **12 feet on center both ways for all suspended ceilings** according to **UBC Standard 25-2**. (Seismic calculations have been done which require rigid struts as 12 feet on center in order to allow for 7/8” perimeter wall molding in lieu of a 2” perimeter wall mold.) In **lieu of compression struts** provide a seismic clip with an **ES Report** number from ICC demonstrating that the compression struts and the 2 inch perimeter wall mold are not required. Equal to:.
   a. **BERC** seismic clips as manufactured by **Armstrong**.
   b. **1496 Perimeter Clip** as manufactured by **Chicago Metallic** Corp.
   c. **ACM-7** clip as manufactured by **USG**.
7. **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 (Z90) coating designation, with pre-finished **15/16-inch- (24-mm-) wide metal caps** on flanges.
   a. Basis of Design: **Armstrong Prelude XL** 15/16 inch **Exposed Tee.**
   b. **Structural Classification**: Heavy-duty system.
   c. **End Condition of Cross Runners**: Butt-edge type.
   d. **Face Design:** Flat, flush.
   e. **Cap Material:** Steel or aluminum cold-rolled sheet.
   f. **Cap Finish:** Painted in color as selected from manufacturer's full range.
      1) **Colors:**
         (a) At Ceiling Type 'D' locations: Silver Satin to match panels.
         (b) All other locations: White.

D. **Miscellaneous Materials**:
   1. **Acoustical Sealant**: Resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for interior sealing of concealed construction joints.
   2. **Edge Trim**:
      a. Basis of Design: Armstrong Ceilings; Axiom.
      b. Trim Height: 4 inches.
      c. Finish: As selected by Architect from manufacturer's full range of custom colors.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **Coordination**: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
   1. Furnish concrete inserts, steel deck hanger clips and similar devices to other trades for installation well in advance of time needed for coordination of other work.

B. **Layout**: Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans wherever possible.

### 3.2 INSTALLATION

A. **General**: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to work.

B. **Arrange acoustical units** and orient directionally-patterned units (if any) in manner shown by reflected ceiling plans.
   1. Install tile with pattern running in one direction.

C. **Install suspension systems** to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0". Comply with detail on drawings for seismic bracing.

D. **Secure wire hangers** by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, countersplaying or other equally effective means.

E. **Install edge moldings** of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
   1. Screw-attach moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.

F. **Install acoustical tile** in coordination with suspension system. Place splines or flanges of suspension system into kerfed edges, or insert tile tongues into tile grooves, so that every tile-to- tile joint is closed by double lap of material.

1. **Fit** adjoining tile to form flush, tight joints. Scribe and cut for accurate fit at borders and around penetrating work.
2. **Hold tile field in compression** by inserting leaf-type spring steel spacers between tile and moldings, spaced at 12" o.c.
3. **Install** acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
4. **Paint** cut and exposed edges of acoustical tile.
5. **Install hold-down clips** in areas indicated, and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

## 3.3 ADJUST AND CLEAN

A. **Clean exposed surfaces** of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION**

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## SECTION 09 6433

## WOOD ATHLETIC-FLOORING ASSEMBLIES

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Maple, strip flooring on floating sub-floor system.

### 1.3 SUBMITTALS

A. **Product Data:** For each type of product indicated.

B. **Shop Drawings**: Show installation details including location and layout of each type of wood, athletic-flooring assembly and accessory. Include the following:
   1. Expansion provisions and trim details.
   2. Layout, colors, widths, and dimensions of game lines and markers.
   3. Locations of athletic equipment floor anchors installed in wood flooring.

C. **Samples for Initial Selection:** Manufacturer's color charts showing colors and glosses available for the following:
   1. Floor finish.
   2. Game-line and marker paint.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications:** An experienced installer who has completed wood, athletic flooring similar in material, design, and extent to that indicated for this Project and whose work has resulted in wood, athletic-flooring installations with a record of successful in-service performance.
   1. Installer's Responsibilities: Installation of flooring assembly, including the following:
      a. Sleepers.
      b. Sub-floor.
      c. Wood finish flooring.
      d. Game lines and markers.
      e. Finish.
      f. Accessories.

B. **Maple Flooring:** Comply with MFMA grading rules for grade and cut.
   1. Certification: Provide flooring that carries MFMA Certification Mark on each piece.

C. **Performance Standards:**

1. Flooring system shall be independently tested and meets or exceeds athletic performance requirements for EN 14904. Independent testing laboratory shall have Scientific Body Membership in the International Association of Sports Surface Sciences (ISSS).
2. Provide flooring system which has been tested in accordance with DIN Standard 18032 Part 2 and meeting the following requirements:
   a. Shock Absorption: 53% minimum.
   b. Vertical Deflection: 2.3 mm minimum
   c. Area of Deflection: 15% maximum
   d. Ball Bounce: 95% or greater.
   e. Surface Friction: 0.59
3. Architect reserves the right to request a 4 foot square mockup of the proposed floor be constructed to demonstrate resiliency and other characteristics for the Owner's observation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** wood-flooring materials in unopened cartons or bundles.

B. **Protect** wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.

C. **Store** wood-flooring materials in a dry, warm, well-ventilated, weather-tight location.

D. **Move wood flooring into spaces** where it will be installed **at least seven days before installation.**

## 1.6 PROJECT CONDITIONS

A. **Conditioning:** Maintain relative humidity conditions planned for building occupants, but not greater or less than the relative humidity range recommended by MFMA, and an ambient temperature between 55 and 75 deg F (13 and 24 deg C) in spaces to receive wood flooring for at least seven days before installation, during installation, and for at least seven days after installation. After post-installation period, maintain relative humidity conditions and ambient temperature planned for building occupants.

1. Open sealed packages to allow wood flooring to acclimatize.
2. Do not install flooring until it adjusts to the relative humidity of and is at the same temperature as the space where it is to be installed.
3. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by flooring and finish manufacturer, but not less than 10 days.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Acceptable Manufacturers:** Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
   1. Connor-AGA: NeoShok Floor
   2. Robbins Sports Surfaces: Bio Cushion Classic
   3. Aacer: AacerFlex
   4. Action: Action Cush I

B. **Finishing Materials:**
   1. Federal, System No. 2588 or Owner approved equivalent compatible with its regular maintenance program.

### 2.2 MAPLE FLOORING

A. **Strip Flooring:** Northern hard maple (Acer saccharum), kiln dried.
   1. Grade: Second and better, unless otherwise indicated.
   2. Cut: Flat sawn.
   3. Lengths: Nominal 15 to 96 inches (381 to 2440 mm) complying with MFMA grading rules, unless otherwise required for patterns indicated.
   4. Matching: Tongue and groove and end matched.
   5. Backs: Channeled (kerfed) for stress relief.
   6. Thickness: 25/32 inch (26 mm).
   7. Face Width: 2-1/4 inches (57 mm).

B. **Subfloor:** Two (2) layers of 15/32 inch APA rated plywood sheathing, Exposure 1.

C. **Fasteners:**
   1. Subfloor: 1 inch (25mm) length x 7/16 inch (11mm) crown, coated staples or equivalent.
   2. Flooring: 2inches (50mm) barbed cleats or staples.

D. **Resilient Pads:** As selected by Architect from manufacturer's full range. Provide data regarding resilience and performance for Architect's information.

### 2.3 FINISHING MATERIALS

A. **Floor-Finish System:** MFMA-listed system of compatible components recommended by flooring and finish manufacturers for application indicated.
   1. Type: Group 3, Gymnasium Type (Surface) Finishes; urethane-oil type.
   2. Floor Sealer: Pliable, penetrating type.
   3. Finish Coats: Formulated for gloss finish and multi-coat application.

B. **Game-Line and Marker Paint:** High-gloss enamel compatible with finish and recommended by finish and paint manufacturers for this purpose.

## 2.4 ACCESSORY MATERIALS

A. **Cork Filler:** 1/2 inch x depth of wood floor system, longest lengths practical; conforming to ASTM 1752, Type II.

B. **Wall Base:** Molded, vented, rubber or vinyl cove base; 4 by 3 by 48 inches (101 by 75 by 1219 mm); with pre-molded outside corners.
   1. Color: As selected by Architect from manufacturer's standard colors.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates, areas and conditions**, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of wood-flooring assembly. Proceed with installation only after unsatisfactory conditions have been corrected.

B. **Concrete Slabs**: Verify that concrete slabs comply with requirements specified in Division 3 Section "Cast-in-Place Concrete."
   1. Grind high spots and fill low spots to provide a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
   2. Verify that slabs are dry according to test methods recommended in writing by flooring manufacturer.

## 3.2 INSTALLATION

A. **General:** Comply with flooring-assembly manufacturer's written instructions, but not less than recommendations of MFMA applicable to flooring type indicated.

B. **Pattern:** Lay flooring parallel with the long dimension of the space to be floored, unless otherwise indicated.

C. **Expansion Spaces:** Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.
   1. Cover expansion spaces with base molding, trim, and saddles, as indicated, at Gymnasium and where indicated on Drawings.
   2. Fill expansion spaces with cork, as indicated, at Racquetball courts and where indicated on Drawings.

D. **Vapor Retarder:** Install with joints lapped a minimum of 6 inches (150 mm) and sealed.

E. Installation Tolerances: 1/8 inch in 10 feet (3 mm in 3 m) variance from level.

## 3.3 FLOATING FLOOR SYSTEM

A. **Cover concrete slab** with polyethylene lapping edges 6” (150mm) and seal with adhesive or 2” (50mm) duct tape.

B. **Attach pads** to the underside of the first layer of plywood 12” (300mm) on center.

C. **Place the first layer of plywood diagonal or perpendicular** to the intended direction of the finish flooring.

D. **Fasten the second layer of plywood** without pads at a 45-degree angle or at right angles to the first layer. The plywood sheets must be nailed or stapled together with 1” (25mm) fasteners starting from the center of the sheet working outward. No joint in the second layer of plywood shall coincide with a joint in the first layer. Allow 1/4" (6mm) between panels at sides and edges, and a 2" (50mm) expansion void at walls and vertical obstructions on both sheets of plywood.

E. **Machine nail strip flooring** into the plywood subfloor, parallel to the long dimension of the area nail approximately 12” (300mm) on-center.

## 3.4 SANDING AND FINISHING

A. **Allow installed flooring to acclimate** to ambient conditions for at least 10 days before sanding.

B. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level floor free of ridges, cups, stop-marks, chatter-marks or swirl marks. Remove sanding dust by tack or vacuum.

C. **Finish:** Apply seal and finish coats of finish system according to manufacturer's written instructions. Provide not less than four coats total and not less than two finish coats.
   1. Lines and Markers: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions. Mask flooring to provide sharp edges. Where game lines cross, break minor game line at intersection; do not overlap lines.

D. **Install base molding and other cover trim** indicated for expansion spaces at edges and interruptions of flooring.

## 3.5 PROTECTION

A. **Protect wood flooring** during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

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# SECTION 09 6513

# RESILIENT FLOOR TILE (VCT)

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Vinyl composition tile (**VCT**).
   2. Resilient **wall base and accessories.**

B. **Related Sections:**
   1. **Division 9** Section "**Finish Schedule**" for product selections and colors.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Samples for Initial Selection**: For each type of product indicated.

C. **Samples for Verification:** Full-size units of each color and pattern of resilient floor tile required.
   1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product color and pattern required.

D. **Maintenance Data:** For resilient products to include in maintenance manuals.

### 1.4 QUALITY ASSURANCE

A. **Fire-Test-Response Characteristics**: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Store** resilient products and installation materials **in dry spaces** protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

## 1.6 PROJECT CONDITIONS

A. **Maintain temperatures** within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After post-installation period, **maintain temperatures within range recommended** by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. **Close spaces to traffic** during floor covering installation.

D. **Close spaces to traffic** for 48 hours after floor covering installation.

E. I**nstall resilient products after other finishing operations**, including painting, have been completed.

## 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. **Floor Tile:** Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. **Resilient Wall Base and Accessories**: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

# PART 2 - PRODUCTS

## 2.1 COLORS AND PATTERNS

A. Colors and Patterns: As listed in the Color Schedule or, if not listed, as selected by Architect from manufacturer's full range.

## 2.2 VINYL COMPOSITION TILE

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is unchanged, as judged by the Architect.
   1. **Manufacturer**: Armstrong.
   2. **Product:**
      a. 12 x 24 inch format: Striations BioBased Tile.
      b. 12 x 12 inch format: Standard Excelon Imperial Texture.

B. **Acceptable Manufacturers:** Subject to compliance with requirements of Contract Documents, provide products by manufacturer listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the provisions of Division 1 Sections.
1. **Armstrong Commercial Flooring;** www.armstrong.com.
2. **Congoleum**; www.congoleum.com
3. Tarkett/**Azrock**; www.azrock.com.
4. **Mannington** Commercial; www.mannington.com

C. **Vinyl Composition Tile (VCT)**: ASTM F 1066, Class 2 (through pattern)
1. Wearing Surface: Smooth.
2. Thickness: 0.125 inch (3.2 mm).
3. Sizes: 12 x 24 inches (305 by 610 mm) and 12 x 12 inches (305 x 305 mm).
4. Recycled Content: 10 percent post-consumer.
5. Fire-Test-Response Characteristics:
   a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

## 2.3 RESILIENT WALL BASE

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is unchanged, as judged by the Architect.
1. **Manufacturer:** Roppe Corporation.
2. **Product:** 700 series.

B. **Acceptable Manufacturers:** Subject to compliance with requirements of Contract Documents, provide products by manufacturer listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the provisions of Division 1 Sections.
1. **Burke** Flooring; www.burkeflooring.com
2. **Johnsonite**; www.johnsonite.com.
3. **Roppe** Corporation; www.roppe.com.

C. **Wall Base: ASTM F 1861.**
1. Type (Material Requirement): TP (rubber, thermoplastic).
2. Group (Manufacturing Method): I (solid, homogeneous).
3. Style: Coved.
4. Minimum Thickness: 0.125 inch (3.2 mm).
5. Height: 4 inches (101.6 mm).
6. Lengths: Coils in manufacturer's standard length.
7. Outside Corners: Pre-molded.
8. Inside Corners: None.
9. Surface: Smooth.

## 2.4 RESILIENT MOLDING ACCESSORY

A. **Applications include** but are not limited to:
1. Carpet edge for glue-down applications
2. Carpet nosing
3. Reducer strip for resilient floor covering.
4. Joiner for tile and carpet.

B. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is unchanged, as judged by the Architect.
   1. Manufacturer: Roppe Corporation.
   2. Product: Rubber accessories.

C. **Acceptable Manufacturers:** Subject to compliance with requirements of Contract Documents, provide products by manufacturer listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the provisions of Division 1 Sections.
   1. Roppe Corporation; www.roppe.com.

## 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 resilient product manufacturer for applications indicated.

B. **Adhesives:** Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. **VOC Content:** No greater than 50 g/L.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. **Prepare substrates** according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   3. Moisture Testing:
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. **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.

D. **Use trowelable leveling and patching compound** to fill cracks, holes, and depressions in substrates.

E. **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 same temperature as space where they are to be installed.

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.

## 3.3 TILE INSTALLATION

A. **Lay out 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 square with room axis.

B. **Match tiles for color and pattern** by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

C. **Scribe, cut, and fit tiles** to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. **Extend tiles** into toe spaces, door reveals, closets, and similar openings.

E. **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.

F. I**nstall tiles on covers** for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. **Adhere tiles to flooring substrates** using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

## 3.4 RESILIENT WALL BASE INSTALLATION

A. **Apply wall base to walls, columns, pilasters, casework and cabinets** in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. **Install wall base in lengths as long as practicable** without gaps at seams and with tops of adjacent pieces aligned.

C. **Tightly adhere wall base to substrate** throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. **Do not stretch** wall base during installation.

E. On masonry surfaces or other similar irregular substrates, **fill voids along top edge of wall base** with manufacturer's recommended adhesive filler material.

F. **Pre-molded Corners:** Install pre-molded corners before installing straight pieces.

## 3.5 RESILIENT ACCESSORY INSTALLATION

A. **Resilient Molding Accessories**: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

## 3.6 CLEANING AND PROTECTION

A. **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.

B. 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.
   1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
      a. Use commercially available product acceptable to manufacturer.
      b. Coordinate selection of floor polish with Owner's maintenance service.
   2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
   3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

**END OF SECTION**

# SECTION 09 6567

# RESILIENT ATHLETIC FLOORING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section include**s the following:
1. Rubber resilient floorings.
2. Floor leveling compound, adhesives and other installation accessories.

B. **Related Sections** include the following:
1. **Division 9** Section "**Finish Schedule**" for product selections and colors.
2. **Division 9** Section "**Resilient Floor Tile**" for wall base and other accessories.

### 1.3 SUBMITTALS

A. **Product Data:** For each type of product indicated.

B. **Shop Drawings:** Show installation details including layout, colors, widths, and dimensions of game lines.

C. **Samples for Selection:** Manufacturer's color charts showing the full range of colors and patterns available for flooring. Include charts showing colors and glosses of game-line and marker paint.

D. **Maintenance Data:** For each type of flooring indicated to include in maintenance manuals specified in Division 1.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. **Deliver materials** in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. **Store materials** to prevent deterioration. Store rolls upright.

C. **Move products into spaces** where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer. Do not install products until they are at the same temperature as the space where they are to be installed.

### 1.5 PROJECT CONDITIONS

A. **Install products after other finishing operations**, including painting, are completed.

B. **Adhesively Applied Products**:

1. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in installation spaces for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post installation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
2. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
3. Do not install products over concrete slabs until slabs have cured and are dry enough to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

## PART 2 - PRODUCTS

### 2.1 RESILIENT ATHLETIC FLOORING - TYPES F6/F7/F8

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be consider provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.

1. **Manufacturer:** Mondo USA.
2. **Product:** Sport Impact, 6 mm.

B. **Substitutions:** Submit products other than the "Basis of Design" as a substitution, according to Conditions of the Contract and Division 1 Sections.

C. **Materials and Construction:** Prefabricated rubber athletic flooring, calendered and vulcanized with a base of natural and synthetic rubbers, stabilizing agents and pigmentation and meeting the following Physical Properties:

1. **Construction and Dimensions:**
   a. Thicknesses: 0.236 inch (6 mm).
   b. Roll Width: 6 feet.
   c. Color and Pattern: As indicated in the Finish Schedule.
   d. Finish: Sealskin.
   e. Construction: Manufactured in two layers which are vulcanized together. The shore hardness of the top layer will be greater than that of the bottom layer; shore hardness of layers to be recommended by the Manufacturer and the limits specified.
2. **Physical Properties:**

| Performance Criteria | Test | Method Result |
|---|---|---|
| Tensile Strength | ASTM D412 | ≥ 500 psi |
| Elongation at Break | ASTM D412 | ≥ 150 percent |
| Hardness Shore A | ASTM D2240 | 80T/70B ± 5 |
| Abrasion Resistance | ASTM D3389 | ≤ 0.5 grams loss |
| Critical Radiant Flux | ASTM E648 | ≥ 0.45 W/cm2, Type I |
| Optical Density of Smoke | ASTM E662 | < 450, Class I |
| Static Load Limit (250 lb) | ASTM F970 | 0.006 in. |
| Fungal Resistance Test | ASTM G21-90 | No growth |
| Coefficient of Friction | ASTM D2047 | ≥ 0.8 dry |

## 2.2 RUBBER TRACK SURFACING - TYPE F9

A. **Acceptable Manufacturer:** Subject to compliance with requirements, provide product listed below only.
   1. **Mondo USA: Super X Performance.**

B. **Construction and Dimensions:**
   1. **Thicknesses:** 0.393 inch (10 mm).
   2. **Sheet Size:** As required to accommodate lane colors with minimal seams or waste of product.
   3. **Color and Pattern:** As shown on Finish Schedule.
   4. **Finish:** Track embossing
   5. **Construction:** Manufactured in two layers which are vulcanized together. The shore hardness of the top layer will be greater than that of the other layer; shore hardness of layers to be recommended by the Manufacturer and the limits specified.
   6. **Physical Properties:**

| Performance Criteria | Test | Method Result |
|---|---|---|
| Hardness Shore A | ASTM D2240 | 50/40 |
| Force Reduction IAAF % | DIN 180383/2 | Between 35+/-1% and 50 +/-1% |
| Modified Vertical Deformation | IAAF | From0.06+/-0.1mm to 2.2+/-.01mm |
| Tensile Properties : Strength | IAAF test | = 0.05 MPa |
| Elongation | IAAF test | >40% |
| Critical Radiant Flux | ASTM E648,NFPA 101 | 0.56 W/cm2, Type I |
| Optical Density of Smoke | ASTM E662 | < 450, Class I |
| Static Load Limit | ASTM F970 | 0.005 in. |
| Coefficient of Friction | ASTM D2047 | > 0.05 wet |

## 2.3 ACCESSORIES

A. **Trowelable Leveling and Patching Compound:** Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. **Adhesives**: Water-resistant type recommended by manufacturer for substrate and conditions indicated.

C. **Chemical-Welding Compound:** Product of flooring manufacturer for welding seams.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates, areas, and conditions** where installation of products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements.

B. **Concrete Substrates**: 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, moisture, and pH tests recommended in writing by flooring manufacturer.
   2. Substrate finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
   3. Substrates 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. **Use trowelable leveling and patching compounds**, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

B. **Remove coatings**, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. **Broom and vacuum clean substrates** to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 FLOORING INSTALLATION, GENERAL

A. **Scribe, cut, and fit flooring** to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

B. **Extend floor coverings** into toe spaces, door reveals, closets, and similar openings, unless otherwise indicated.

C. **Maintain reference marker**s, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on finish flooring. Use nonpermanent, nonstaining marking device.

D. **Adhere products to substrates** using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
   1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

E. Mask flooring at game lines and markers, and apply paint to produce sharp edges.

## 3.4 SHEET FLOORING INSTALLATION

A. **Lay out sheet flooring** to comply with the following requirements:
   1. Maintain uniformity of flooring direction.

   2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches (150 mm) from parallel joints in flooring substrates.
   3. Match edges of sheet flooring for color shading and pattern at seams.
   4. Avoid cross and butt seams.

## 3.5 CLEANING AND PROTECTING

A. **Perform the following operations** immediately after installing flooring products:
   1. Remove adhesive and other surface blemishes using cleaner recommended in writing by flooring manufacturer.
   2. Sweep and vacuum floor thoroughly.
   3. Do not wash floor until after waiting period recommended in writing by flooring manufacturer.
   4. Damp mop floor to remove marks and soil using method and cleaner recommended in writing by flooring manufacturer.

B. **Protect flooring** against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
   1. Apply protective floor polish to floor surfaces that are free from soil, adhesive, and surface blemishes.
   2. Do not move heavy or sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

**END OF SECTION**

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## SECTION 09 6633

## PRECAST TERRAZZO STAIR TREADS

### PART 1 - GENERAL

### 1.1 SUMMARY

A. **Work of this Section** includes:
   1. Precast **terrazzo stair treads**

B. **Setting materials.**

C. Polishing and finishing **maintenance materials.**

D. **Related work** not specified under this section
   1. **Division 5** Section "**Metal Fabrications**" for steel stairs and supports for precast treads.
   2. **Division 5** Section "**Glass Railings**" for railings and railing supports at Grand Stair.

### 1.2 REFERENCES

A. National Terrazzo and Mosaic Association (NTMA) Standards.

### 1.3 SUBMITTALS

A. **Product Data:** Submit manufacturer's specifications and technical data for precast terrazzo stair treads; including manufacturer's printed installation instructions and maintenance manuals for each material specified.

B. **Shop Drawings**: Show detail sections and profile of all precast items. Details shall show all reinforcing, and special hardware for fastening rails. Show installation and attachment details.
   1. Design stair treads, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. **Samples for Selection**: Submit manufacturer's samples of actual sections of tile and accessories; include manufacturer's full range of color and patterns available.

D. **Samples for Verification Prior to Installation**: Submit full size samples of all types, colors, and patterns selected, indicating full range of patterning and color variations.

### 1.4 QUALITY ASSURANCE

A. **Setting Materials**: Provide materials obtained from one source for each type and color of setting materials.

B. **NTMA Standards:** Comply with specified provisions and recommendations of NTMA

C. Manufacturer to supply a written **Quality Assurance Program and Procedure Manual.**

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Packaging and Shipping**: Precast terrazzo to be delivered in original unopened packaging with legible manufacturer identification, including size, quantity, manufacture date, and inspector initials

B. **Storage and Protection**: Precast terrazzo to be stored indoors, sheltered from moisture in original packaging. Protect from damage by other trades.

## 1.6 PROJECT CONDITIONS

A. **Inspect surfaces** to receive precast stair treads and do not proceed with installation until improper conditions have been corrected.

B. Provide temperatures in precast terrazzo areas during installation and after completion as required by installation standard or manufacturer's instructions, but not less than 50 degrees F.

## 1.7 WARRANTY

A. Precast terrazzo specialties shall be warranted against product defects for **one year** from date of Substantial Completion.

## 1.8 MAINTENANCE

A. **Extra Materials**: Deliver supply of maintenance materials to the Owner. Furnish maintenance materials from same lot as materials installed, and enclosed in protective package with appropriate identifying labels.
   1. Furnish not less than two treads in longest length used on project as attic or maintenance stock of each type, color pattern, and size of precast terrazzo product installed.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers offering products with equivalent products may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer**: Wausau Tile, Inc.
   2. **Product:** C-60 Self-supporting Flat Treads, 3-12 inches thick (min); customized as shown on Drawings and as required by structural design.

B. **Substitutions:** Submit products other than the "Basis of Design" as a substitution, according to Conditions of the Contract and Division 1 Sections.

## 2.2 MATERIALS

A. **Portland Cement**: Conforming to ASTM C-150; **white**.

B. **Aggregates**: Meeting ASTM C-33 and ASTM C-131 and complying with NTMA requirements; natural, sound, crushed marble chips without excessive flats or flakes, approximately 1/4 to 3/8 inch.

C. **Sand:** Clean, washed, locally available.

D. **Color Pigments**: Inorganic, resistant to alkalinity, pure mineral or synthetic, non-fading; used per manufacturer's recommendations.

E. **Thinnest Mortar:** Exceeding ANSI A118.4

## 2.3 MANUFACTURED UNITS

A. **Fabrication:**
1. Size: Full treads, as indicated on Drawings.
2. Chamfered face edges.
3. Surface: Ground & polished, free of holes or rough areas; uniform in appearance.
4. Abrasive Safety Lines: Provide three lines of abrasive inserts

B. **Finish/Color**: As selected by Architect from manufacturer's full range.

C. **Manufacturing Process:**
1. Mechanically vibrate terrazzo mix in molds.
2. Hydraulically press using 900-ton/3250 psi press.
3. Steam-cure with 100 percent humidity for 12 hours at 170 degrees F.
4. Factory finish: In-line grinding.

D. **Tolerances:**
1. Dimensional tolerances: Fact: toe - 1/32”; thickness +/- 1/16”
2. Warpage: Along with any edge +/- 1.5 percent
3. On either diagonal +/- 1.5 percent
4. Wedging: Not to exceed 1.0 percent

## 2.4 SOURCE QUALITY CONTROL

A. Manufacturer to supply independent laboratory for test results on:
1. Flexural strength ASTM C-293
2. Water absorption ASTM C-140
3. Compressive strength ASTM C-140

B. Inspections:
1. Documented inspection of precast terrazzo quality control tests

# PART 3 - EXECUTION

## 3.1 PREPARATION GUIDELINES

A. Complete and approve the following work before installation of precast terrazzo is begun:
1. Surface to receive precast terrazzo shall be plumb, level, and true with square corners, maximum variation from required plane shall be 1/8” in 10 feet.
2. All anchors, outlets and other inserts must be in place.

## 3.2 INSTALLATION GUIDELINES

A. Perform work using trade contractor, tile and marble setters, and finishers who are thoroughly competent to execute the work and have had successful experience with projects of similar magnitude to this project.

B. Follow all current TCA guidelines and ANSI A108.1B

C. Set accurately as shown on approved shop drawings and as detailed on Drawings.

**END OF SECTION**

# SECTION 09 6813

# CARPET TILE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** modular, fusion-bonded **carpet tile**.

B. **Carpet shall be provided per State Contract MA2097.**

C. **Related Sections** include the following:
1. **Division 9** Section "**Finish Schedule**" for product selections and colors.
2. **Division 9** Section "**Resilient Floor Tile**" for resilient wall base and accessories installed with carpet tile.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. **Shop Drawings**: Show the following:
1. Carpet tile type, color, and dye lot.
2. Type of subfloor.
3. Type of installation.
4. Proposed pattern of installation.
5. Pile direction.
6. Type, color, and location of insets and borders.
7. Type, color, and location of edge, transition, and other accessory strips.
8. Transition details to other flooring materials.

C. **Samples**: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. **Product Schedule**: For carpet tile. Use same designations indicated on Drawings.

E. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency.

F. **Maintenance Data**: For carpet tiles to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

G. **Warranty**: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. **Fire-Test-Response Characteristics**: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. **Product Options**: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered.

D. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:
   1. Review delivery, storage, and handling procedures.
   2. Review ambient conditions and ventilation procedures.

E. **Mock-ups**: Provide a mock-up for each type of carpet installation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI "Carpet Installation Standard - 2011", Section 5, "Storage and Handling."

## 1.6 PROJECT CONDITIONS

A. Comply with CRI "Carpet Installation Standard - 2011", Section 7.2, "Site Conditions - All Installations" and Section 11, "Ventilation."

B. **Environmental Limitations**: Do not install carpet tiles 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 tiles** over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

## 1.7 WARRANTY

A. **Special Warranty for Carpet Tiles**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, dimensional stability, and delamination.
   3. Warranty Period: Lifetime Commercial Limited.

## 1.8 EXTRA MATERIALS

A. **Furnish extra materials** described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. **Carpet Tile**: Full-size units equal to **5 percent** of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

# PART 2 - PRODUCTS

## 2.1 CARPET TILE

A. **Acceptable Manufacturer:** Subject to compliance with requirements of Contract Documents, provide products by manufacturer listed below.
   1. **Manufacturer:** Patcraft, division of Shaw Industries Group.
   2. **Products:**
      a. **General (Field):** Idea Modular (style # 10294); "Mindset".
      b. **Accent:** Idea Modular (style #10294); "Insight".

B. **Carpet Properties**:
   1. **Construction:** Multi-level pattern loop.
   2. **Fiber Product**: Solution Q® Extreme nylon.
   3. **Protective Treatments**: SSP® Shaw Soil Protection.
   4. **Gauge**: 1/12.
   5. **Stitches per inch**: 10.0.
   6. **Finished Pile Thickness**: 0.104 inches.
   7. **Weight Density**: 167,530.
   8. **Dye Method**: 100% solution dyed.
   9. **Secondary Backing**: Eco Worx® Tile.
   10. **Warranty**: Lifetime Commercial Limited.

## 2.2 INSTALLATION ACCESSORIES

A. **Trowelable Leveling and Patching Compounds**: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. **Adhesives**: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile 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 tile manufacturer.
   2. 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 "Carpet Installation Standard - 2011", Section 8, "Substrates," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. **Use trowelable leveling and patching compounds**, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. **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 manufacturer.

D. **Broom and vacuum clean substrates** to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

A. **General**: Comply with CRI "Carpet Installation Standard - 2011", Section 18, "Modular Carpet," and with carpet tile manufacturer's written installation instructions.

B. **Installation Method**: Glue down; install every tile with full-spread, **releasable, pressure-sensitive adhesive**.

C. **Maintain dye lot integrity**. Do not mix dye lots in same area.

D. **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.

E. **Extend carpet tile into toe spaces**, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. **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, nonstaining marking device.

G. **Install pattern parallel** to walls and borders. **Pattern as determined by Architect** prior to beginning installation.

## 3.4 CLEANING AND PROTECTION

A. **Perform the following operations** immediately after installing carpet tile:
   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.
   3. **Vacuum carpet tile** using commercial machine with face-beater element.

B. **Protect installed carpet** tile to comply with CRI "Carpet Installation Standard - 2011", Section 16, "Protecting Indoor Installations."

C. **Protect carpet tile** against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION**

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## SECTION 09 7250

## PRESENTATION WALL COVERINGS

### PART 1 - GENERAL

### 1.1 SUMMARY

A. **Section includes** products identified on the Drawings as "tackable wall system" or "whiteboard":
   1. **Dry erase wall covering**.
   2. Resilient cork/linoleum **tackable wall covering**.
   3. **Accessories**.

### 1.2 RELATED DIVISIONS:

A. **Division 09** Section "**Gypsum Board**" for wall substrate and wall reveals.

B. **Division 09** Section "**Painting**" for priming for wall coverings.

### 1.3 REFERENCES

A. **American Society for Testing and Materials (ASTM)**: Test Method for Surface Burning Characteristics of Building Materials.

B. **Gypsum Association GA-14-M-97**: Recommended Levels of Gypsum Board Finish.

### 1.4 SUBMITTALS

A. Manufacturer's **product data and installation instructions** for each type of dry erase wallcovering, adhesive, and accessories required.

B. Manufacturer's written **product data indicating compliance** with specified materials required.

C. Manufacturer's written instructions for **recommended maintenance** of each type of dry erase wallcovering.

D. **Samples:**
   1. 7 x 9 inch samples of each dry erase material.
   2. 7 x 9 inch samples of each tackable wall covering.

### 1.5 QUALITY ASSURANCE

A. **Manufacturer:** Provide each type of dry erase and tackable wallcovering produced by one manufacturer.

B. **Installer**: Installation by skilled commercial wallcovering contractor with no less than three years of documented experience installing dry erase wallcovering of the types and extent required.

C. **Composition:**
   1. **erase•rite®**: Provide non-woven or self-adhesive backing, pigmented vinyl capped with dry erase low gloss film.
   2. **tac•wall®:** Provide resilient homogeneous tackable linoleum surface consisting of linseed oil, granulated cork, rosin binders, and dry pigments calendered onto natural burlap backing. Color shall extend through thickness of material.

D. **Surface Burning Characteristics Classification:** Provide materials that meet Class I/A rating when tested in accordance with ASTM E84 for flame spread and smoke developed

E. **Field Samples:** Prepare field samples for Architect's review and establish requirements for seaming and finish trim.
   1. Install sample panel of each type presentation wallcovering specified in area designated by Architect.
   2. Correct areas, modify method of application/installation, or adjust finish texture as directed by Architect to comply with specified requirements.
   3. Maintain corrected and approved samples to serve as a standard of performance for the project.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Deliver** presentation wallcoverings to the project site **in unbroken and undamaged original factory packaging** and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.

B. **Store materials in a clean, dry storage area** with temperature maintained above 55° F with normal humidity.

C. **Store material within original packaging** to prevent damage.

## 1.7 PROJECT CONDITIONS

A. **Do not apply presentation wallcoverings** when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.

B. **Provide continuous ventilation and heating** facilities to maintain substrate surface and ambient temperatures above 55° F unless required otherwise by manufacturer's instructions.

C. **Apply adhesive** when substrate surface temperature and ambient temperature is above 55° F and relative humidity is below forty percent.

D. **Maintain constant recommended temperature** and humidity for at least seventy-two hours prior to and throughout the installation period, and for seventy-two hours after wallcovering installation completion.

E. **Provide not less than 80-foot-candles per square foot** lighting level measured mid-height at substrate surfaces.

## 1.8 WARRANTY

A. Submit manufacturer's limited **five-year written warranty** against manufacturing defects.

## 1.9 MAINTENANCE

A. Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURER

A. **Basis of Design Wallcoverings:** Walltalkers Wallcoverings manufactured by RJF International Corporation, Fairlawn, Ohio; www.walltalkers.com

B. **Alternate systems** shall be submitted for review by the Architect prior to the receipt of bids. Alternative systems are subject to all requirements of these specifications. Documentation shall verify compliance with design criteria outlined herein and as shown on the Drawings.

## 2.2 MATERIALS

A. **Walltalkers erase•rite**: Smooth low gloss vinyl surface for projection and dry erase markers.
   1. ER60: 59/60 inch width, 18 ounce per square yard, non-woven backing, color as selected by Architect from manufacturer's full range.

B. **Walltalkers tac•wall:** Uni-color resilient homogeneous tackable linoleum surface consisting of linseed oil, granulated cork, rosin binders, and dry pigments calendered onto natural burlap backing. Color shall extend through thickness of material.
   1. Width: 48 inches.
   2. Gage: 1/4 inch.

## 2.3 ALUMINUM TRIMS

A. Refer to **Division 9** Section "**Gypsum Board**" for coordinating horizontal functional reveals and 1/2 inch vertical reveals.

## 2.4 ACCESSORIES

A. **Adhesives:**
   1. Dry erase material: Heavy-duty clear or clay based premixed vinyl adhesive.
   2. Tackable material: Solvent-free, SBR type linoleum adhesive (L-910) or polyvinyl acetate dispersion type (contact adhesive) when used in a press.
   3. All adhesives shall be low VOC.

B. **Substrate Primer/Sealer:** White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates and installation conditions** to ensure surface conditions meet or exceed a **Level 5 finish**, per GA-214-M-97: Recommended Levels of Gypsum Board Finish. Permanent lighting should be installed and operational.

B. **Test substrate** with a suitable moisture meter and verify that moisture content does not exceed four percent.

C. **Verify substrate surface** is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.

D. **Evaluate all painted surfaces** for the possibility of pigment bleed-through.

E. **Notify the Contractor and Architect** in writing of any conditions detrimental to the proper and timely completion of the installation.

F. Beginning of installation means acceptance of surface conditions.

### 3.2 PREPARATION

A. Remove hardware, accessories, plates and similar items to allow wallcoverings to be installed.

B. Gypsum Board Surfaces: Recess nails and screws. Repair irregular tape joints, sand and remove dust.

C. **Seal wall surfaces properly with a quality primer** specified for use under flexible vinyl wall coverings.
   1. Primer: Use a quality pigmented acrylic wallcovering primer.

### 3.3 INSTALLATION - DRY ERASE WALLCOVERING

A. **Acclimate wallcovering** in the area of installation a minimum of twenty-four hours before installation.

B. **Read and follow the manufacturer's installation instruction** sheet contained in each roll of the dry erase wallcovering.

C. **Examine all materials** for pattern, color, quantity and quality, as specified for the correct location prior to cutting.

D. **Adhesive:** Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.

E. **Install each strip horizontally** and in the same sequence as cut from the roll.

F. **Install dry erase wallcovering sheets** in exact order as they are cut from bolt. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.

G. **Install dry erase wallcovering horizontally** using a level line.

H. Using a level or straight edge, **double cut the seam** with a seam-cutting tool (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material.

I. When covering the entire wall, **seam the material out of the main writing and viewing areas** of the wall.

J. **Apply wallcovering to the substrate** using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.

K. **Remove excess adhesive immediately** after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.

L. **Stop installation of material that is questionable** in appearance and notify the manufacturer's representative for an inspection.

## 3.4 INSTALLATION - TACKABLE WALLCOVERING

A. **Comply with manufacturer's printed installation instructions.**

B. **Cut sheets to size** including a few inches of overage. Allow sheets to lay flat for at least twenty-four hours prior to the application. Mark roll direction and sequence on the backside of each sheet. Hang sheets in sequence as cut from the roll, do not reverse sheets. Lay out material to minimize seams.

C. **Permanent HVAC system should be set to 68 degrees** Fahrenheit (20 degrees Celsius) for at least seventy-two hours prior to, during, and after the installation.

D. **Back roll each sheet** prior to the installation to release curl memory.

E. For seamed applications, using a seam and strip cutter **remove the factory edge of one sheet**. Using the same tool, overlap and trace cut the mating edge of the second sheet. Repeat this step for as many sheets as required for the job.

F. **Scribe, cut, and fit material** to butt tightly to adjacent surfaces, built-in casework, and permanent fixtures and pipes. Joints in tackable material shall be butted tight.

G. **Apply adhesive** with a 1/16 inch square notch trowel to the area to receiving the sheet (apply enough for one sheet at a time).

H. **Work from top to bottom** then side to side. Roll sheet firmly into adhesive for positive contact and to remove air bubbles.

I. **Remove adhesive residue immediately** after each panel is hung with a mild soap/water solution and a soft cloth/sponge.

J. **Stop installation of material that is questionable** in appearance and notify the manufacturer's representative for an inspection.

## 3.5 CLEAN-UP

A. Upon completion of installation, **remove all exposed adhesive immediately** using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.

B. Upon completion of the work, **remove surplus materials, rubbish, and debris** resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.

**END OF SECTION**

# SECTION 09 8433

# ACOUSTICAL WALL AND CEILING PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
1. Acoustical **wall** panels.
2. Acoustical **ceiling** panels.
3. **Softwood trim** around wall panel edges.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Shop Drawings**: Show fabrication and installation details for acoustical panels, including plans, elevations, sections, details, and attachments to other Work.

C. **Samples**: 8-by-11-inch units of each type of acoustical panel indicated. Include samples of installation devices and accessories.

D. **Maintenance Data**: For acoustical panels to include in maintenance manuals specified in Division 1.

### 1.4 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A firm experienced in manufacturing acoustical panels similar to those indicated for this Project and with a record of successful in-service performance.

B. **Source Limitations for Acoustical Panels**: Obtain acoustical panels from one source with resources to provide products of consistent quality in appearance and physical properties.

C. **Fire-Test-Response Characteristics**: Provide acoustical panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical panels with appropriate markings of applicable testing and inspecting agency.
1. **Flame Spread**: 25 or less.
2. **Smoke Developed:** 450 or less.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Protect acoustical panels** from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install acoustical panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. **Air-Quality Limitations**: Protect acoustical panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

C. **Field Measurements**: Verify surface dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. **Established Dimensions**: Where field measurements cannot be made without delaying the Work, establish surface dimensions and proceed with fabricating acoustical panels without field measurements. Coordinate construction to ensure that actual surface dimensions correspond to established dimensions.

## 1.7 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. **Acoustical Panels**: Full-size units equal to **2 percent** of amount installed.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers offering equivalent products may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Tectum, Inc.
   2. **Product:** Finale Wall Panel System.

## 2.2 MATERIALS

A. **Panels**
   1. Wall and ceiling panels shall be standard 2" thick, including factory assembled glass fiber insulation with dimensions shown on the Drawings.
   2. **Panels shall be fabricated from aspen wood fibers** bonded with an inorganic hydraulic binder. Panel shall have 0-25 flame spread and 0-450 fuel contribution in accordance with ASTM E 84.
   3. **Provide beveled** edge.

B. **Unfaced, Glass-Fiber Board Insulation**: Thermal insulation combining glass fibers with thermosetting resin binders to comply with ASTM C 612, Type IA and IB; and with other requirements indicated below:
   1. **Nominal density** of 2.5 lb/cu. ft., thermal resistively of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
   2. **Surface-Burning Characteristics**: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

C. **Softwood Trim Around Panel Edges**: Provide finished lumber and moldings complying with the following requirements including those of the grading agency listed with species:
   1. Species: Poplar; NLGA, WCLIB, or WWPA.
   2. Grade: B & Btr. Select or Supreme.
   3. Texture: Surfaced (smooth).
   4. Lumber for Painted Finish: Glued-up lumber or solid lumber stock

D. **Miscellaneous Materials**:
   1. **Acoustical Sealant**: Resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for interior sealing of concealed construction joints.

## 2.3 ACOUSTICAL PANELS, GENERAL

A. **Fabricate panels** to sizes and configurations indicated.

B. **Dimensional Tolerances of Finished Units**: Plus or minus 1/16 inch for the following:
   1. Thickness.
   2. Edge straightness.
   3. Overall length and width.
   4. Squareness from corner to corner.
   5. Chords, radii, and diameters.

C. **Sound-Absorption Performance**: Provide acoustical panels with minimum noise reduction coefficients indicated, as determined by testing per ASTM C 423 for mounting type specified.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates** and blocking, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting acoustical panel performance. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. **Install acoustical panels** in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
   1. **Cut units to be at least 50 percent of unit width**. Scribe acoustical panels to fit adjacent work. Butt joints tightly.

B. **Construction Tolerances**: As follows:
   1. **Variation from Plumb and Level:** Plus or minus 1/16 inch.
   2. **Variation of Joints from Hairline**: Not more than 1/16 inch.

## 3.3 CLEANING

A. **Remove surplus materials**, rubbish, and debris resulting from acoustical panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

## 3.4 PROTECTION

A. **Provide final protection** and maintain conditions, in a manner acceptable to manufacturer and Installer, and ensure acoustical panels are without damage or deterioration at time of Substantial Completion.

B. **Replace panels** that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

**END OF SECTION**

## SECTION 09 9100

## PAINTING

### PART 1 - GENERAL

### 1.1 SUMMARY

A. **Section includes** painting work, **interior** and **exterior**. Work Includes, but is not limited to painting the following:
   1. **Exterior** steel.
   2. Metal **doors**, metal **door frames**, **grilles**, **frames** and fire extinguisher **cabinet doors**.
   3. Exterior metal **mechanical units**, **grilles** and **louvers**.
   4. **Interior walls** and **ceilings**.
   5. **Interior** steel rails and misc. metal.
   6. **Exterior** exposed metal **flashing**.
   7. **Interior** and **exterior** wall mounted **speakers**.
   8. **Interior** and exterior masonry. (**See Division 7 for interior and exterior water repellents**.)
   9. Interior **wood**.
   10. **Work includes** field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, plug mold, electric panels, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.

B. "**Paint**" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

C. **Surfaces to be Painted**: Except where natural finish of material is specifically noted as a surface not to be painted, paint all exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. **If color or finish is not designated**, Architect will select these from manufacturer's **full range** of colors and finishes.
   1. **Multiple colors will be selected** by the Architect for any type of paint system. **If colors are not indicated** on the drawings, provide for a minimum of **20 percent** of the **walls** to be an **accent color**.
   2. **Surface preparation**, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
   3. **Walls behind scheduled coverings** shall receive prime coat.
   4. **All speakers, fire extinguisher cabinets**, etc. are to be painted to match the adjacent wall surface as directed by the Architect.
   5. **If it can be seen**, paint it.

D. **Following categories of work are not included** as part of field-applied finish work:
   1. **Pre-Finished Items**: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, pre-finished partition systems, architectural woodwork and casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.

2. **Concealed Surfaces**: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces and duct shafts.
3. **Finished Metal Surfaces**: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
4. **Operating Parts**: Unless otherwise indicated, 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.
5. **Labels**: Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

E. **Related Sections**:
1. **Shop Primers**: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
   a. **Unless otherwise specified**, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.
2. **Division 7** Section "**Intumescent Paints**" for coatings applied for fireproofing. Verify final finish requirements and apply top coat where required.

F. **Related Documents**: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

## 1.2 SUBMITTALS

A. **Product Data**: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed for use.
1. Provide certification that paint products used contain zero volatile organic compounds (VOCs). Where zero VOC products are not available for unique applications, provide coatings with lowest VOC possible.

B. **Samples**: Prior to beginning work, review Finish Schedule for colors to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.
1. **On 12" x 12" hardboard**, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.
2. **On actual wood surfaces**, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.
3. **On actual wall surfaces** and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface, or as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.
   a. **Final acceptance of colors** will be from samples applied on the job.

## 1.3 QUALITY ASSURANCE

A. **Single Source Responsibility**: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. **Coordination of Work**: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

## 1.4 DELIVERY AND STORAGE

A. **Deliver materials** to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
   1. Name or title of material.
   2. Fed. Spec. number, if applicable.
   3. Manufacturer's stock number and date of manufacture.
   4. Manufacturer's name.
   5. Contents by volume, for major pigment and vehicle constituents.
   6. Thinning instructions.
   7. Application instructions.
   8. Color name and number.

B. **Store materials** not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
   1. **Protect from freezing where necessary**. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

## 1.5 JOB CONDITIONS

A. **Apply water-base paints** only when temperature of surfaces to be painted and surrounding air temperatures are between 50 deg. F and 90 deg. F, unless otherwise permitted by paint manufacturer's printed instructions.

B. **Apply solvent-thinned paints** only when temperature of surfaces to be painted and surrounding air temperatures are between 45 deg. F and 95 deg. F, unless otherwise permitted by paint manufacturer's printed instructions.

C. **Do not paint in snow, rain, fog or mist,** or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
   1. **Painting may be continued during inclement weather if** areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

D. **Determine moisture content of surfaces** to be painted by performing appropriate tests using a commercially available moisture meter. Apply paint only when surfaces are within limits specified by the paint manufacturer’s printed instructions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. **Acceptable Manufacturers**: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
   1. **Devoe** Paints.
   2. **ICI** Paint Stores.
   3. **PPG** Industries, Pittsburgh Paints
   4. **Pratt and Lambert**.
   5. The **Sherwin-Williams** Company.
   6. **Benjamin Moore** & Co.
   7. **Comex/Kwal** Paint.

### 2.2 MATERIALS

A. **Material Quality**: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. **Proprietary names** used to designate color or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

C. **Federal Specifications** establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.

D. **Manufacturer's products** which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

E. **Color Pigments**: Pure, non-fading, applicable types to suit substrates and service indicated.

F. **Lead content in pigment**, if any, is limited to contain no more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.
   1. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors which are readily accessible to children under seven years of age.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Applicator must examine areas** and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

B. **Starting of painting work** will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. **Do not paint over dirt**, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

### 3.2 PREPARATION

A. **General**: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. **Barrier Coats**: Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

C. **Accessories Removal**: Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

D. **Surface Preparation**: Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

E. **Cementitious Materials**: Prepare cementitious surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
   1. **Determine alkalinity and moisture content** of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
   2. **Clean concrete floor surfaces** scheduled to be painted with a commercial solution or muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

F. **Ferrous Metals**: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
   1. **Caulk fabrication joints** in hollow metal door frames which paint application cannot bridge.

G. **Touch-up**: Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

H. **Galvanized Surfaces**: Clean free of oil and surface contaminants with non-petroleum based solvent.

I. **Wood**: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, fry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

1. **Prime, stain, or seal wood** required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.
2. **When transparent finish is required**, use spar varnish for back priming.

J. **Materials Preparation**:

1. **Mix and prepare** painting materials in accordance with manufacturer's directions.
2. **Maintain containers** used in mixing and application of paint in a clean condition, free of foreign materials and residue.
3. **Stir materials before application** to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

## 3.3 APPLICATION

A. **General**: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. **Paint colors**, surface treatments, and finishes, are indicated in "schedules" of the contract documents.
2. **Provide finish coats** which are compatible with prime paints used.
3. **Apply additional coats** when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. **Paint surfaces behind movable equipment** and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
5. **Paint interior surfaces of ducts**, where visible through registers or grilles, with a flat, non-specular black paint.
6. **Paint back sides of access panels**, and removable or hinged covers to match exposed surfaces.
7. **Finish doors on tops**, bottoms and side edges same as faces, unless otherwise indicated.
8. **Sand lightly** between each succeeding enamel or varnish coat.
9. **Omit first coat** (exterior faces) of surfaces which have been **shop-primed** and touch-up painted, unless otherwise indicated.
10. **All speakers, fire extinguisher cabinets**, etc. are to be painted to match the adjacent wall surface as directed by the Architect.

B. **Scheduling Painting**: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. **Re-coat Time**: Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firms, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

2. **Minimum Coating Thickness**: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

C. **Mechanical and Electrical Work**: Painting of mechanical and electrical work is limited to those items exposed to mechanical equipment rooms and in occupied spaces.

1. **Mechanical items** to be painted include, but are not limited to, the following:
   a. Piping, pipe hangers, and supports.
   b. Roof mounted mechanical units.
   c. Ductwork, where exposed in occupied spaces.
   d. Motor, mechanical equipment, and supports.
   e. Accessory items.
2. **Electrical items** to be painted include, but are not limited to, the following:
   a. Conduit and fittings.

D. **Prime Coats**: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

1. **Recoat primed and sealed surfaces** where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. **Pigmented (Opaque) Finishes**: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

F. **Completed Work**: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

## 3.4 FIELD QUALITY CONTROL

A. **The right is reserved by Owner to invoke the following material testing procedure** at any time, and any number of times during period of field painting:

1. **Owner will engage services of an independent testing laboratory** to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.
   a. **Testing laboratory** will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

b. **If test results show** that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

## 3.5 CLEAN-UP AND PROTECTION

A. **Clean-Up**: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.
   1. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using car not to scratch or otherwise damage finished surfaces.

B. **Protection**: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
   1. **Provide "Wet Paint" signs** as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
   2. **At completion of work of other trades**, touch-up and restore all damaged or defaced painted surfaces.

C. **Extra Stock**: Deliver stock or maintenance materials to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.
   1. **Paint**: Furnish not less than one (1) full gallon for each color and type of paint installed.

## 3.6 EXTERIOR PAINT SCHEDULE

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Acceptable manufacturers** are listed above in paragraph 2.1.

B. **METAL** (Aluminum)
   **Sherwin-Williams** - Latex (100% Acrylic) Systems
   **1st Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series
   **2nd Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series
   **Finish**: Gloss
   **Thickness**: (Mils per coat) **6 - 12** wet; **2.5 - 4** dry.

C. **METAL** (Galvanized)

**Sherwin-Williams** - Latex (100% Acrylic) Systems

**1st Coat**: S-W **Pro Industrial Pro-Cryl Universal Primer**, B66-310 Series
**Finish**: Low sheen
**Thickness**: (Mils per coat) **5 - 10** wet; **2.0 - 4.0** dry.

**2nd Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series

**3rd Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series
**Finish**: Gloss
**Thickness**: (Mils per coat) **6 - 12** wet; **2.5 - 4** dry.

D. **METAL** (Misc. Iron, Ornamental Iron, Cat Walks, Fire Escapes, Hydrants, Handrails, Ladders, Fences etc.)

**Sherwin-Williams** - Latex (100% Acrylic) Systems

**1st Coat**: S-W **Pro Industrial Pro-Cryl Universal Primer**, B66-310 Series
**Finish**: Low sheen
**Thickness**: (Mils per coat) **5 - 10** wet; **2.0 - 4.0** dry.

**2nd Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series

**3rd Coat**: S-W **Pro Industrial Zero VOC Acrylic Gloss**, B66-600 Series
**Finish**: Gloss
**Thickness**: (Mils per coat) **6 - 12** wet; **2.5 - 4** dry.

E. **METAL** Exposed Exterior Structural Steel Elements (Columns, Trusses, Decking etc.)

**Surface Preparation**: **Remove all oil and grease** from surface with aromatic solvent wipe, such as **Xylene** or **Med**. Protect adjacent surfaces from damage. Prepare surface in accordance with commercial blast cleaning **SSPC-SP6** with median surface profile of 1.5 to 2.0 mils.

**Sherwin-Williams** - Polyamide Epoxy (primer) / Aliphatic Polyurethane (finish)

**1st Coat**: SW **MacroPoxy 646-100**, B58 series.
**Finish**: Flat
**Sheen**: Low sheen
**Thickness**: (Mils per coat) **7 - 13.5** wet; **5 - 10** dry.

**2nd Coat**: SW **Water-Based Acrolon 100 Polyurethane Gloss**, B65-700 Series.

**3rd Coat**: SW **Water-Based Acrolon 100 Polyurethane Gloss**, B65-700 Series.
**Finish**: High Gloss
**Thickness**: (Mils per coat) **4 - 8** wet; **2 - 4** dry.

F. **MASONRY** (**Exterior Painted** - Concrete Masonry Units - exterior)

**Sherwin-Williams** - Latex (100% Acrylic) Systems:
**1st Coat**: S-W **Loxon Exterior Acrylic Masonry Primer**, A24W200 Series
**Finish**: Flat
**Sheen**: (Percent at 60 deg) less than **10%**
**Thickness**: (Mils per coat) **6 - 8** wet - **3 - 4** dry.
**2nd Coat**: S-W **A-100 Exterior Latex Satin** A82 Series.
**Finish**: Satin
**Sheen**: (Percent at 60 deg) **10-20%**
**Thickness**: (Mils per coat) **6 - 8** wet - **3 - 4** dry.

G. **MASONRY** (**Sealed** exterior masonry – See **Division 7** for **Water Repellents**)

## 3.7 INTERIOR PAINT SCHEDULE

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
1. **Acceptable manufacturers** are listed above in paragraph 2.1.

B. **MASONRY PAINTED** (Interior Concrete Masonry Units)

**Sherwin-Williams** - Vinyl Acrylic Systems
**1st Coat:** S-W **ProMar Interior/Exterior Block Filler** B25W25
**Finish**: Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **16** wet - **8** dry.
**2nd Coat:** S-W **ProMar 200 Zero VOC** Semi-Gloss B31-2600 Series
**3rd Coat:** S-W **ProMar 200 Zero VOC** Semi-Gloss B31-2600 Series
**Finish**: Semi-Gloss
**Thickness**: (Mils per coat) **4** wet - **1.5** dry.

**Sherwin-Williams** - Epoxy System - 100% Acrylic base coat (Water Base)
**1st Coat:** S-W **Heavy Duty Block Filler**, B42W46 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) less than **10%**
**Thickness**: (Mils per coat) **16** wet - **8** dry.
**2nd Coat**: S-W **Pro Industrial Zero VOC Water-Based Epoxy Gloss** B73-300 Series.
**3rd Coat**: S-W **Pro Industrial Zero VOC Water-Based Epoxy Gloss** B73-300 Series.
**Finish**: Semi-Gloss
**Sheen**: (Percent at 60 deg) **25-35%**
**Thickness**: (Mils per coat) **4** wet - **1.5** dry.

C. **METAL** - (Interior Galvanized)

**Sherwin-Williams** - Vinyl Acrylic with 100% Acrylic primer:

**1st Coat** S-W **Pro Industrial Pro-Cryl Universal Primer** B66-310 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) less than **10%**
**Thickness**: (Mils per coat) **10** wet - **5** dry.

**2nd Coat**: S-W **Pro Industrial Zero VOC Acrylic** Semi-Gloss **B66-650** Series

**3rd Coat**: S-W **Pro Industrial Zero VOC Acrylic** Semi-Gloss B66-650 Series
**Finish**: Semi-Gloss
**Sheen**: (Percent at 60 deg) **25-35%**
**Thickness**: (Mils per coat) **3.5** wet - **1.3** dry.

D. **METAL** - (Interior Structural Steel **-** Columns, Joists, Trusses, Beams - Misc. & Ornamental Iron, Doors, Door Frames, Non-Galvanized Metal)

**Sherwin-Williams** - Vinyl Acrylic with 100% Acrylic primer:

**1st Coat** S-W **Pro Industrial Pro-Cryl Universal Primer** B66-310 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) less than **10%**
**Thickness**: (Mils per coat) **10** wet - **5** dry.

**2nd Coat**: S-W **Pro Industrial Zero VOC Acrylic** Semi-Gloss B66-650 Series

**3rd Coat**: S-W **Pro Industrial Zero VOC Acrylic** Semi-Gloss B66-650 Series
**Finish**: Semi-Gloss
**Sheen**: (Percent at 60 deg) **25-35%**
**Thickness**: (Mils per coat) **3.5** wet - **1.3** dry.

E. **DRYWALL** (Walls, Ceilings, Gypsum Board, Etc.)

**Sherwin-Williams** - Vinyl Acrylic Systems

**1st Coat**: S-W Promar **200 Zero VOC Latex** Wall Primer, B28W2600 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **4.3** wet - **1.2** dry.

**2nd Coat**: S-W **ProMar 200 Zero VOC** Semi-Gloss, B31-2600 Series

**3rd Coat**: S-W **ProMar 200 Zero VOC** Semi-Gloss, B31-2600 Series
**Finish**: Semi-Gloss
**Sheen**: (Percent at 60 deg) **25-35%**
**Thickness**: (Mils per coat) **3.5** wet - **1.3** dry.

F. **DRYWALL** (Interior **Epoxy System** - Walls, Ceilings, Gypsum Board, Etc.)

**Sherwin-Williams** - **Epoxy** System (Water Base) with Vinyl Acrylic Primer
**1st Coat**: S-W **ProMar 200 Zero VOC Interior Latex** Wall Primer
**Finish**: Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **4.3** wet; **1.2** dry.
**VOC**: 87 g/L
**2nd Coat**: S-W **Pro Industrial Zero VOC Water-Based Epoxy**, B73-300 Series
**3rd Coat**: S-W **Pro Industrial Zero VOC Water-Based Epoxy**, B73-300 Series
**Finish**: Gloss
**Sheen** (Percent at 85 deg): **25 - 35**
**Thickness**: (Mils per coat) **4.0** wet; **1.5** dry.

G. **DRYWALL** (Interior **Graphics**, **Deep Tone Accents, Special Features**, Etc.)

**Sherwin-Williams** - Vinyl Acrylic
**1st Coat**: S-W **ProMar 200 Zero VOC Interior Latex Wall Primer,** B28W2600 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **4.3** wet - **1.2** dry.
**2nd Coat**: S-W **ProMar 200 Zero VOC Eg-Shel** B26-2600 series
**3rd Coat**: S-W **ProMar 200 Zero VOC Eg-She**l B26-2600 series
Provide **additional coats as required** to provide full coverage of surfaces.
**Finish**: Satin
**Sheen**: (Percent at 85 deg) **10-20%**
**Thickness**: (Mils per coat) 3.5 wet - **1.5** dry.

H. **DRYWALL** (Interior Behind Wall Panels, Casework, in mechanical plenums, etc.)

**Sherwin-Williams** - Vinyl Acrylic
**1st Coat**: S-W **ProMar 200 Zero VOC Interior Latex Primer**, B28W2600 Series
**Finish**: Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **4.2** wet - **1.2** dry.

I. **ACOUSTICAL PANELS** (Interior Tectum)

**Sherwin-Williams** - Vinyl Acrylic
**1st Coat**: S-W **ProMar 200 Zero Interior Latex Primer**, B28W2600 Series
**Finish**: Non-bridging Flat
**Sheen**: (Percent at 85 deg) **0-5%**
**Thickness**: (Mils per coat) **4.3** wet - **1.2** dry.
**2nd Coat**: S-W **ProMar 200 Zero VOC Flat** B30-2600 series
**Finish**: Non-bridging Flat
**Sheen**: (Percent at 85 deg) **0-2%**
**Thickness**: (Mils per coat) **4** wet - **1.3** dry.

J. **CONCRETE SLABS** (Floors **not otherwise scheduled** for special applied finishes in such areas as **Janitor's Closets,** etc.). Floors scheduled for "traffic coating" and mechanical rooms with piping or other possibility of leaks - see Division 7 Section "Traffic Coatings".

**1st coat**: '**Selby 700**' Series apply at a rate recommended by manufacturer.
**2nd coat**: '**Selby N300CR**' Series apply at a rate recommended by manufacturer.
**Color**: As selected by the Architect from the manufacturer's standard colors.

K. **WOODWORK** (Stained & Varnished - Clear Finish**)**

**Open Grained** Wood
**1st Coat**: S-W **WoodClassics 250 g/L Stain**, A49W800 Series
**2nd Coat**: S-W **SHERWOOD Natural Filler**, D70T1
**3rd Coat**: S-W **WoodClassics WB Polyurethane**, A68 Series
**4th Coat**: S-W **WoodClassics WB Polyurethane**, A68 Series

**Closed Grain** Wood
**1st Coat**: S-W **WoodClassics 250 g/L Stain**, A49W800 Series
**2nd Coat**: S-W **WoodClassics WB Polyurethane**, A68 Series
**3rd Coat**: S-W **WoodClassics WB Polyurethane**, A68 Series

L. **WOODWORK** (Natural - Clear Finish)

**Open Grained** Wood
**1st Coat**: S-W **SHERWOOD Natural Filler**, D70T1
**2nd Coat**: S-W **WoodClassics WB Polyurethane,** A68 Series
**3rd Coat**: S-W **WoodClassics WB Polyurethane,** A68 Series

**Closed Grain** Wood
**1st Coat**: S-W **WoodClassics WB Polyurethane,** A68 Series
**2nd Coat**: S-W **WoodClassics WB Polyurethane,** A68 Series

M. **WOODWORK** (Painted)

**Latex Systems**
**Semi-Gloss Finish**
**1st Coat**: S-W **ProMar 200 Zero VOC Primer**, B28W2600 Series
**2nd Coat**: S-W **ProMar 200 Zero VOC Semi-Gloss** B31-2600 Series
**3rd Coat**: S-W ProMar 200 Zero VOC Semi-Gloss B31-2600 Series
**Thickness:** **4** mils wet; **1.5** mils dry per coat

N. **PIPE INSULATION/IDENTIFICATION - (Pipe Wrapping, Etc.)**

**Latex Systems**
**Flat Finish**
**1st Coat**: S-W **ProMar 200 Zero VOC Flat**, B30-2600 Series
**Thickness**: **4** mils wet; **1.2** mils dry
**2nd Coat**: S-W **ProMar 200 Zero VOC Flat**, B30-2600 Series
**Thickness:** **4** mils wet; **1.2** mils dry

**END OF SECTION**

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# DIVISION 10 - SPECIALTIES


| | |
|---|---|
| Section 10 1100 | Visual Display Boards |
| Section 10 1400 | Signs |
| Section 10 2114 | Toilet Compartments (Phenolic) |
| Section 10 2600 | Wall/Corner Guards |
| Section 10 2800 | Toilet and Bath Accessories |
| Section 10 4400 | Fire Protection Specialties |
| Section 10 5129 | Solid Phenolic Lockers |

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## SECTION 10 1100

## VISUAL DISPLAY BOARDS & BULLETIN BOARDS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following types of visual display boards:
   1. **Porcelain enamel** marker boards (for liquid chalk).
   2. **Vinyl-faced** cork tack boards.

B. **Related Sections**: The following sections contain requirements that relate to this section:
   1. **Division 6** Section "**Miscellaneous Carpentry**" for wood blocking and grounds.
   2. **Division 12** Section "**Manufactured Cabinets and Casework**" for tack boards located between upper and lower work counters.

### 1.3 SUBMITTALS

A. **General**: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data**: Product data for each type of marker board and tack board specified, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. **Shop Drawings**: Provide shop drawings for each type of marker board, and tack board required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

D. **Samples**: Provide the following samples of each product for selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
   1. **Samples** for selection of color, pattern, and texture:
      a. **Porcelain Enamel Marker Board**: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of marker board required.
      b. **Vinyl-fabric-faced Cork Tack Boards**: Manufacturer's color charts consisting of actual sections of vinyl fabric, showing the full range of colors, textures, and patterns available for each type of vinyl-fabric-faced cork tack board indicated.
      c. **Aluminum Trim and Accessories**: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.

E. **Certificates**: In lieu of laboratory test reports, when permitted by the Architect, submit the manufacturer's certification that vinyl-fabric-faced cork tack board materials furnished comply with requirements specified for flame spread ratings.

## 1.4 QUALITY ASSURANCE

A. **Fire Performance Characteristics**: Provide vinyl-fabric-faced tack boards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
   1. **Flame Spread:** 25 or less.
   2. **Smoke Developed:** 10 or less.

B. **Design Criteria**: The drawings indicate sizes, profiles, and dimensional requirements of visual display boards and bulletin boards. Other visual display boards having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof of equality is on the proposer.

C. **Special Construction**: Provide visual display boards which have been manufactured to **special sizes compatible with vertical wall standards** and **mounting clips** furnished in **Division 9** Section - **Tackable Wall System/Vinyl Wall Panels**. Provide steel gussets, attached at each corner to trim members of board for reinforcement.

## 1.5 PROJECT CONDITIONS

A. **Field Measurements**: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.
   1. Allow for trimming and fitting wherever taking field measurements before fabrication might delay the Work.

## 1.6 WARRANTY

A. **Porcelain Enamel Chalkboard Warranty**: Furnish the manufacturer's written warranty, agreeing to replace porcelain enamel chalkboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking, provided the manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.
   1. **Warranty Period**: **Lifetime** of the building.

## 1.7 ALLOWANCES

A. **Contractor** shall include an **additional four (4) 48" x 96" vinyl fabric faced tack boards**, to be located as directed by the architect, beyond that which is required by the contract documents. Cost to include installation and general contractor's mark up.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products may be incorporated in the work include, but are not limited to, the following:

1. **Porcelain Enamel Marker Boards and Tack Boards**:
   a. **Best-Rite** Chalkboard Co.
   b. **Claridge** Products and Equipment, Inc.
   c. **ADP/Lemco**, Inc.
   d. **Inwest** Manufacturing, Salt Lake City, Jeff Lavery 801-808-7434.
   e. **LBI/Boyd**.

### 2.2 MATERIALS

A. **Porcelain Enamel Marker Boards**: Provide balanced, high-pressure- laminated porcelain enamel chalkboards of 3-ply construction consisting of face sheet, core material, and backing.

1. **Face Sheet**: Provide face sheet of 24-gage enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
   a. **Cover Coat**: Provide the manufacturer's standard light-colored special writing surface with **gloss finish** intended for use with liquid felt-tipped markers.
2. **Core**: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.
3. **Backing Sheet**: Provide the manufacturer's standard 0.015-inch- thick aluminum sheet backing.
4. **Laminating Adhesive**: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.

B. **Vinyl-Fabric-Faced Tack Boards**: Provide mildew-resistant, washable, vinyl fabric.

1. **Backing**: Make panels rigid by factory laminating cork face sheet under pressure to 1/4-inch-thick hardboard backing.
2. **Vinyl Facing**: See **Finish Schedule** for vinyl type and color or if not in color schedule as specified by Architect from manufacturer's full range.

### 2.3 ACCESSORIES

A. **Metal Trim and Accessories**: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.

1. **General**: Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer's standard structural support accessories to suit the condition indicated.
2. **Field-Applied Trim**: Provide the manufacturer's standard screw-on trim with Phillips flat-head screws.

3. **Chalktray**: Furnish the manufacturer's standard continuous, solid extrusion-type aluminum chalktray with ribbed section and smoothly curved exposed ends, for each chalkboard.
4. **Map Rail**: Furnish map rail at the top of each unit, complete with the following accessories:
   a. **Display Rail**: Provide continuous cork display rail approximately 1 or 2 inches wide, as indicated, integral with the map rail.

## 2.4 FABRICATION

A. **Porcelain Enamel Markerboards**: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.

B. **Assembly**: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.
1. **Make joints** only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.
2. **Provide the manufacturer's standard vertical joint system** between abutting sections of markerboard.
3. **Provide manufacturer's standard mullion trim** at joints between markerboard and tackboard.

## 2.5 FINISHES

A. **General**: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. **Finish**: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

C. **Class I, Clear Anodic Finish**: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.7 mil [0.018 mm] or thicker) complying with AAMA 607.1.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. **Deliver** factory-built marker board, tack board and bulletin board units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. **Install** units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.

C. **Coordinate** job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

## 3.2 ADJUST AND CLEAN

A. **Verify** that accessories required for each unit have been properly installed and that operating units function properly.

B. **Clean units** in accordance with the manufacturer's instructions. Break in marker boards only as recommended by the manufacturer.

**END OF SECTION**

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# SECTION 10 1400

# SIGNS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following types of signs:
   1. **Panel signs**.
      a. **Handicap accessibility** signs.
      b. **Handicapped entry** signs.
      c. **Maximum occupancy** load signs
   2. **Vinyl Graphics** - Pressure Sensitive.
   3. **Parking and Traffic Signs**.
      a. **Parking signs** – handicapped.
      b. **Site directional** signs.
   4. **Building Identification and Plaques**.
      a. **Dimensional letters** and **numbers**.
      b. Building **address**.
      c. Metal **plaques**

### 1.3 SUBMITTALS

A. **General**: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data**: Provide product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. **Shop drawings**: Provide shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
   1. Provide message list for each sign required, including large-scale details of wording and lettering layout.

D. **Samples**: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
   1. Samples for selection of color, pattern, and texture:
      a. **Cast Acrylic Sheet and Plastic Laminate**: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

## 1.4 QUALITY ASSURANCE

A. **Sign Fabricator Qualifications**: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. **Single-Source Responsibility**: For each separate sign type required, obtain signs from one source of a single manufacturer.

C. **Handicapped Accessibility**: Provide signs which are in conformance with the requirements of ANSI A117.1-1998 and the Americans with Disabilities Act of 1990 (ADA).

D. **Design Concept**: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

## 1.5 DELIVERY AND HANDLING

A. **Delivery**: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.

B. **Handling**: Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage.
   1. Inspect sign components for damage on delivery.
   2. Do not install damaged sign components.
   3. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by Architect; otherwise, remove and replace damaged sign components.

## 1.6 PROJECT CONDITIONS

A. **Field Measurements**: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

## 1.7 WARRANTY

A. **General Warranty**: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. **Warranty Period**: 5 years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

1. **Manufacturers of Panel Signs**:
   a. A. R. K. Ramos
   b. Allotech, Inc.
   c. Andco Industries
   d. ASI Sign Systems, Inc.
   e. Best Manufacturing Company.
   f. Gemini
   g. Interpretive Graphics
   h. Kroy Architectural Signing
   i. Thomas & Sons LLC.
   j. Vomar Products, Inc.

### 2.2 MATERIALS

A. **Raised Graphics and Tactile Signs**: Provide chemically welded, adhesive mounted or glued and mechanically engraved graphics, text and Braille panels that comply with requirements indicated for materials, thickness, colors, designs, shapes sized and details of construction.

1. Panel signs shall comply with applicable provisions of the ADA Accessibility Guidelines (ADAAG) and ICC / ANSI A177.1/98 including 0.0312" raised tactile characters, 4.0" pictograms, 0.625" upper case text, sans serif type styles and Grade II Braille shall be positioned directly beneath the text.

B. **Cast Acrylic Sheet**: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:

1. **Opaque Sheet**: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

### 2.3 PANEL SIGNS

A. **General**: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch1.5 mm measured diagonally.

B. **Basis-of-Design Product**: **ASI Sign Systems**, Inc.; **ADA-Ready**, **In Touch System** or a comparable product of one of the other manufacturers listed.

C. **Materials**:
   1. **Acrylic**: Non-glare acrylic sheet, continuously processed with a matte finish that complies with ANS Z97.1-1984 Safety Glazing requirements.
   2. **Vinyl**: 3M Scotchcal film Series 220/Series 225 precision plotted in sizes and colors indicated.

D. **Unframed Panel Signs**: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:
   1. **Edge Condition**: Square cut.
   2. **Corner Condition**: Square.
   3. **Depth**: 0.25 inch thickness.
   4. **Panel Appearance**: As selected by Architect.
   5. **Color**: As selected by Architect from manufacturers full range of colors.
   6. **Surface Texture**: As selected by Architect.
   7. **Letter Style**: Arial.
   8. **Letter Height**: As scheduled.

E. **Graphic Content and Style**: Provide sign copy that complies with requirements indicated in the **Sign Schedule** for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.
   1. Provide signage indicating **handicap entry** at each set of ADA accessible entry doors into facility.
   2. Provide **maximum occupancy load** signs in assembly rooms as required by code.

F. **Tactile and Braille Copy**: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   1. **Raised-Copy Thickness**: Not less than 1/32 inch0.8 mm.

G. **Colored Coatings**: For copy and background colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

H. **Metal Finishes**: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

I. **Aluminum Finishes**: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
   1. **Baked-Enamel Finish**: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
      a. **Organic Coating**: Thermosetting-modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.
         1) **Color**: As **selected by the Architect** from the manufacturer's standard colors.

## 2.4 PRESSURE SENSITIVE VINYL GRAPHICS

A. **Provide graphics** on **pressure sensitive vinyl film** where indicated on the drawings. Vinyl to be equal to:
   1. **3M 'Scotchcal'** changeable translucent graphic film **IJ63-20**.
   2. **Graphics** are to be provided by the Architect in digital format and are to be transferred to the vinyl as a **digital print**.

## 2.5 PAINTED/STENCILED SIGNS

A. **At fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions** or any other wall required to have protected openings or penetrations, provide permanent painted signage.

B. **Locate signage in accessible, but concealed, spaces**, such as above finished lay-in ceilings, attic spaces, etc. Signage shall be placed so as to be visible to any tradesman performing work at the wall. Signs shall be repeated at intervals not less than 30 feet, measured horizontally along wall.

C. **Lettering**: 3/4 inch high, minimum; black or other contrasting color.

D. **Wording**: "FIRE OR SMOKE BARRIER. PROTECT ALL OPENINGS".

## 2.6 EXTERIOR DIRECTIONAL AND PARKING SIGNS

A. **Panel Signs**: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

B. **Steel Posts**:
   1. **Basis of Design**: "**Telespar Square Sign Supports**" an manufactured by "**Allied Tube and Conduit**" www.alliedtube.com.
   2. **Post Size**: 2 by 2 inches (50 by 50 mm) square, perforated, welded steel tubing,14 gauge with a pre galvanized G90 finish.
   3. **Post Anchor**: Provide a post anchor consisting of two telescoping tubes:
      a. **Inner Tube**: Inner tube to be a 12 gauge 2 1/4" x 2 1/4" x 36" long tube.
      b. **Outer Tube**: Outer tube to be a 12 gauge 2 1/2" x 2 1/2" x 18" long tube.
      c. **Setting Post Anchor**: Set two anchor tubes flush with each other at the top and set the anchor 2" to 4" above concrete to allow for post to be connected.

C. **Sign Panels**: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.
   1. **Unframed Single-Sheet Panels**: Provide unframed single-sheet sign panels with edges mechanically and smoothly finished to conform to the following:
      a. **Panel Material**: 0.08-inch- (2-mm-) thick **aluminum** sheet.
         1) **Panel Finish**: Manufacturer's standard semi gloss finish with UV inhibitors.
      b. **Edge Condition**: Square cut.
      c. **Corner Condition**: 1/2" radius corners.

D. **Graphic Content and Style**: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

1. **Copy on Panels**: Apply computer-generated adhesive graphics to panel. Graphics to be engineer grade vinyl. Apply as per manufacturer's recommendations
   a. Provide signage indicating handicap parking at all handicap parking spaces.
   b. Provide directional signage on site for bus, automobile and pedestrian access.

E. **Fabrication**:

1. **General**: Provide manufacturer's standard single-post, single-panel-type post and panel signs. The completed sign assembly shall consist of a message panel supported on 1 post. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   a. **Allow for thermal movement** resulting from a maximum ambient temperature change (range) of 100 deg F (38 deg C). Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners.
      1) Base design on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.
   b. **Welded Connections**: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress on exposed and contact surfaces.
   c. **Mill joints to a tight, hairline fit**. Form joints exposed to the weather to exclude water penetration.
   d. **Preassemble signs** in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
   e. **Conceal fasteners** if possible; otherwise, locate fasteners where they will be inconspicuous.
2. **Posts**: Fabricate posts to lengths required for mounting method indicated.
   a. Direct Burial: For permanent sign installation, provide posts 36 inches (900 mm) longer than height of sign to permit direct embedment in concrete foundations.
3. **Panels**: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
   a. **Coordinate dimensions** and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
   b. **Increase metal thickness** or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
   c. **Continuously weld joints and seams**, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

## 2.7 DIMENSIONAL LETTERS AND NUMBERS

A. **Cast Letters and Numbers**: Form individual letters and numbers by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.
   1. **Metal**: Aluminum.
   2. **Building Name**: Provide letters of size and style **as indicated on the Drawings or if not indicated** provide **18 inch high** letters for the **building name** and **10 inch high** letters for the **building address**. Attach to exterior of building as directed by Architect.

## 2.8 CAST METAL PLAQUES

A. **Plaques**: Castings shall be free from pits, scale, sand holes, or other defects. Comply with requirements specified for metal, border style, background texture, and finish and with requirements shown for thickness, size, shape, and copy. Hand-tool and buff borders and raised copy to produce the manufacturer's standard satin polished finish.
   1. **Metal**: Aluminum.
   2. **Border Style**: Raised flat band.
   3. **Background Texture**: Manufacturer's standard pebble texture.
   4. **Background Finish**: Provide the manufacturer's standard baked-enamel finish.

B. **Provide one (1) 18 x 24 inch cast metal plaque,** allow text as indicated below.
   1. Title of project.
   2. Seal of the State of Utah.
   3. Date of dedication.
   4. Names of State and University Officials
   5. Name of Contractor.
   6. Name of Architect.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. **General**: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
   1. Install signs level, plumb, and at the height indicated, with sign surfaces free from

B. **Wall-Mounted Panel Signs**: Attach panel signs to wall surfaces using the methods indicated below:
   1. **Interior Wall Signs**: Install signs as indicated on the drawings or if not indicated then as follows: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
      a. **Mounting Method – smooth surfaces**: Use two-face tape. Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
      b. **Mounting Method – rough or vinyl surfaces**: Use silicone-adhesive mounting. Attach signs to irregular, porous, or vinyl-covered surfaces.

c. **Signs Mounted on Glass**: Use **two-face tape**. Provide matching opaque plate (plate to be of the same color and texture as the sign.) on opposite side of glass to conceal mounting materials.

C. **Vinyl Graphics - Pressure Sensitive:** Apply to substrate as per manufacturer's written recommendations.

D. **Exterior Directional and Parking Signs**:

1. **Excavation**: In firm, undisturbed or compacted soil, drill or (using a post-hole digger) hand-excavate holes for each post to the minimum diameter recommended by sign manufacturer, but at least 4 times the largest post cross-section.
   a. Excavate hole depths approximately 3 inches (75 mm) lower than required post bottom, with bottom of posts set at least 36 inches (900 mm) below finished grade.
2. **Setting Posts**: Center and align posts in holes 3 inches (75 mm) above bottom of excavation.
   a. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check posts for vertical and top alignment and hold in position until concrete has achieved its initial set.

E. **Metal Plaques**: Mount plaques using the standard method recommended by the manufacturer for the type of wall surface indicated.

1. **Concealed Mounting**: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

F. **Dimensional Letters and Numbers**: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners. Letters are to be offset from wall surface.

## 3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

**END OF SECTION**

# SECTION 10 2114

# TOILET COMPARTMENTS (PHENOLIC)

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** toilet compartments and screens as follows:
   1. **Type**: **Phenolic** core.
   2. **Compartment Style**: Overhead braced and floor anchored.
   3. **Urinal Screen Style**: **Wall mounted**.

B. **Related Sections** include the following:
   1. **Division 10** Section "**Toilet and Bath Accessories**" for toilet paper holders, grab bars, purse shelves, and similar accessories.

### 1.3 SUBMITTALS

A. **Product Data**: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. **Shop Drawings**: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. **Samples for Selection**: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.

### 1.4 PROJECT CONDITIONS

A. **Field Measurements**: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. **Established Dimensions**: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Accurate** Partitions Corp.
   2. **American Accessories**, Inc.
   3. **Columbia** Partitions as manufactured by PSISC
   4. **DesignRite**.
   5. **General** Partition
   6. **Global** Partitions.
   7. **Metpar** Corp.

### 2.2 MATERIALS

A. **General**: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.

B. **Solid Phenolic Core**: Toilet partitions shall be constructed of **polycarbonate/phenolic resins**. Material shall have a non-ghosting, graffiti resistant surface integrally bonded to the core through a series of manufacturing steps requiring thermal and mechanical pressure. Provide units with eased edges and with minimum **3/4-inch-** (19-mm-) **thick doors** and pilasters and minimum **3/4**-inch- (19-mm-) thick panels and screens. Provide melamine color as follows:
   1. **Colors:** Colors as selected by Architect from manufacturer's full range of colors.

C. **Pilaster Shoes and Sleeves** (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 inch (0.8 mm) thick and 3 inches (75 mm) high, finished to match hardware.

D. **Full-Height** (Continuous) **Brackets**: Manufacturer's standard design for attaching panels and screens to walls and pilasters of the following material:
   1. **Material**: Stainless steel.

E. **Hardware and Accessories**: Manufacturer's standard design, **heavy-duty** operating hardware and accessories of the following material:
   1. **Material**: Stainless steel 304.

F. **Overhead Bracing**: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile in manufacturer's standard finish.

G. **Anchorages and Fasteners**: Manufacturer's standard exposed fasteners of **stainless steel** 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.

## 2.3 FABRICATION

A. **General**: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
   1. **Provide internal reinforcement** in metal units for compartment-mounted hardware, accessories, and grab bars, as indicated.

B. **Overhead-Braced-and-Floor-Anchored Compartments**: 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.

C. **Floor-Anchored Screens**: Provide pilasters and panels of same construction and finish as toilet compartments. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

D. **Urinal Screens**: Provide **wall mounted** urinal screens as per manufacturer's standard.

E. **Doors**: Unless otherwise indicated, provide **24-inch-** (610-mm-) wide **in-swinging** doors for standard toilet compartments and **36-inch-** (914-mm-) wide **out-swinging** doors with a **minimum 32-inch-** (813-mm-) wide clear opening for compartments indicated to be **handicapped** accessible.
   1. **Hinges**: **Self-closing** type that can be **adjusted** to hold door open at any angle **up to 90 degrees**. Provide full height, continuous **piano type** door hinge of **extruded aluminum**, 6063-T5, **bright anodized** finish or **Type 304**, **16 gauge satin-finish stainless stee**l. Knuckles shall have nylon separators. **Pivot pin** shall be **1/4"** type 304 stainless steel. Hinge shall be predrilled for stainless steel tamper proof bolts, spaced at maximum 8" on center. Provide **snap on cover** over fasteners, attached at top and bottom with theft proof fasteners.
   2. **Latch and Keeper:** Manufacturer's heavy-duty cast stainless steel surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
   3. **Coat Hook**: Manufacturer's heavy-duty cast stainless steel combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
   4. **Door Bumper:** Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.
   5. **Door Pull**: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. **General**: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch (13 mm) between pilasters and panels and not more than 1 inch (25 mm) between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.

1. **Secure panels to walls** and panels with continuous brackets. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

B. **Overhead-Braced-and-Floor-Anchored Compartments**: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than 2 fasteners. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. **Screens**: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

## 3.2 ADJUSTING AND CLEANING

A. **Hardware Adjustment**: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

B. **Provide final protection** and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

# SECTION 10 2600

# WALL/CORNER GUARDS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following types of protection guards:
   1. **Stainless steel** corner/wall guards.

### 1.3 SUBMITTALS

A. **General**: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data**: Product data for each type of wall and corner guard specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. **Drawings**: Shop drawings detailing fabrication and installation of wall and corner guards. Include plans, elevations, and large-scale details showing layout and types required. Show anchorages and accessory items.

### 1.4 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A firm experienced in manufacturing wall and corner guards similar to that indicated for this Project and that has a record of successful in-service performance.

B. **Design Criteria**: The drawings indicate sizes, profiles, and dimensional requirements of the various items of wall and corner guards and are based on the specific types and models indicated. Similar equipment by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

## PART 2 - PRODUCTS

### 2.1 STAINLESS STEEL CORNER GUARDS

A. **Surface-Mounted, Metal Corner Guards**: Fabricated from 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in the Contract Documents is not changed, as judged by the Architect.
   a. **Manufacturer:** Construction Specialties, Inc.
   b. **Product:** Model CO-8.
2. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   a. **ARDEN** Architectural Specialties, Inc.
   b. **Balco**, Inc.
   c. **Boston Retail** Products.
   d. **Construction Specialties**, Inc.
   e. **C/S Group** Mississauga, Ontario Canada. www.c-sgroup.com
   f. **IPC** Door and Wall Protection Systems; Division of InPro Corporation.
3. **Material**: Stainless steel, Type 304.
   a. **Thickness**: Minimum 0.0625 inch (1.6 mm).
   b. **Finish**: Directional satin, No. 4.
4. **Wing Size**: Nominal 3-1/2 by 3-1/2 inches (90 by 90 mm).
5. **Corner Radius**: 1/8 inch (3 mm).
6. **Mounting**: Adhere to wall with adhesive as recommended by the corner guard manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. **General**: Coordinate installation of wall and corner guards indicated to be attached to concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
   1. Coordinate delivery of anchoring devices to Project site to avoid delaying progress.

### 3.2 INSTALLATION

A. **General**: Comply with manufacturer's detailed instructions for installing wall and corner guards.

B. **Wall/Corner Guards**: Install wall surface protection units plumb, level, and true to line without distortions.
   1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished work.

### 3.3 ADJUST AND CLEAN

A. After installation, restore marred, abraded surfaces to the original condition.

**END OF SECTION**

# SECTION 10 2800

# TOILET AND BATH ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes toilet** and **bath accessories** including but not limited to the following:
1. **Grab bars**.
2. **Sanitary Napkin** Vendor
3. **Sanitary Napkin Disposal** Unit.
4. **Shelf Unit**.
5. **Warm-air** dryers.
6. **Under lavatory** guards.
7. **Folding** shower seat.
8. **Shower curtain** and **rod**.
9. **Mop and broom holder**.

B. **Related Sections** include the following:
1. **Division 8** Section "**Mirrored Glass**" for plate glass mirrors at lavatories.
2. **Division 10** Section "**Toilet Compartments**" for compartments and screens.

### 1.3 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. **Samples**: For each accessory item to verify design, operation, and finish requirements.
1. Approved full-size Samples will be returned and may be used in the Work.

C. **Setting Drawings**: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. **Product Schedule**: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

E. **Maintenance Data**: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

## 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. **Product Options**: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
   1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
   2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

## 1.5 COORDINATION

A. **Coordinate accessory locations** with other work to prevent interference with clearances required for access by disabled persons, 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.

## 1.6 WARRANTY

A. **General Warranty**: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Manufacturer's Mirror Warranty**: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
   1. **Minimum Warranty Period**: **15 years** from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Toilet and Bath Accessories**:
      a. **A & J** Washroom Accessories, Inc.
      b. **American** Specialties, Inc.
      c. **Bobrick** Washroom Equipment, Inc.
      d. **Bradley** Corporation.
   2. **Hand Dryers**:
      a. Dyson, Inc.
      b. Mitsubishi.
   3. **Under lavatory Guards**:
      a. **Brocar** Products, Inc.
      b. **Truebro**, Inc.

## 2.2 MATERIALS

A. **Stainless Steel**: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. **Brass**: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. **Sheet Steel**: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. **Galvanized Steel Sheet**: ASTM A 653/A 653M, G60.

E. **Chromium Plating**: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. **Baked-Enamel Finish**: Factory-applied, gloss-white, baked-acrylic-enamel coating.

G. **Mirror Glass**: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

H. **Galvanized Steel Mounting Devices**: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

I. **Fasteners**: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

## 2.3 FABRICATION

A. **General**: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. **Surface-Mounted Toilet Accessories**: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. **Recessed Toilet Accessories**: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. **Keys**: Provide universal keys for internal access to accessories for servicing and resupplying. 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. **Secure mirrors** to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. **Install grab bars** to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

A. **Adjust accessories** for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. **Remove temporary labels** and protective coatings.

C. **Clean and polish** exposed surfaces according to manufacturer's written recommendations.

### 3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. **Toilet Tissue Dispenser**: Furnished and installed by Owner. Contractor to verify and install necessary wall blocking to properly support unit.

B. **Paper Towel Dispenser:** Furnished and installed by Owner. Contractor to verify and install necessary wall blocking to properly support unit.

C. **Soap Dispenser**: Furnished and installed by Owner. Contractor to verify and install necessary wall blocking to properly support unit.

D. **Grab Bars**: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
   1. **Basis of Design:** Bobrick, B-6806 Series. Length as indicated on Drawings.
   2. **Stainless-Steel Nominal Thickness**: Minimum 0.05 inch.
   3. **Mounting**: Concealed with manufacturer's standard flanges and anchors.
   4. **Finish**: Satin.
   5. **Outside Diameter**: 1-1/2 inches for heavy-duty applications.

E. **Sanitary Napkin Vendor**: Where this designation is indicated, provide stainless-steel sanitary napkin vendor complying with the following:
   1. **Basis of Design:** Bobrick, B-47064 25
   2. **General**: Fabricate cabinet of all-welded construction. Provide seamless door with returned edges and secured by tumbler lockset. Provide identification reading "**Napkins**" and "**Tampons**"; brand-name advertising is not allowed. Capacity not less than 20 napkins and 30 tampons.
   3. **Mounting**: Semi-recessed type designed for nominal 4-inch wall depth.
   4. **Operation**: Single-coin operation, **25 cents** (field adaptable to 50 cents).

F. **Sanitary Napkin Disposal Unit**: Where this designation is indicated, provide stainless-steel sanitary napkin disposal unit complying with the following:
   1. **Basis of Design:** Bobrick, B-270.
   2. **Surface-Mounted Type:** With seamless exposed walls; self-closing top cover; locking bottom panel with stainless-steel, continuous hinge; and removable, reusable receptacle.

G. **Shelf Unit:** Where this designation is indicated, provide shelf unit complying with the following:
   1. **Basis of Design:** Bobrick, B-287.
   2. **Folding Utility Shelf:** 14-9/16-inch- (370-mm-) long by 5-13/16-inch- (148-mm-) wide shelf fabricated of minimum nominal 18 gauge (1.2-mm-) thick stainless steel, with exposed edges turned down. Equip with heavy duty internal spring. Shelf capacity: 100 lbs (45.36 Kg). Shelf shall automatically return to upright position when not in use.

H. **Mop and Broom Holder:** Where this designation is indicated, provide mop and broom holder complying with the following:
   1. **Basis of Design:** Bobrick, B-224x36.
   2. **Mop and Broom Holder with Utility Shelf:** 36-inch- long unit fabricated of minimum nominal 0.05-inch- thick stainless steel with shelf; support brackets for wall mounting; three hooks for wiping rags; four spring-loaded, rubber hat, cam-type, mop/broom holders mounted on front of shelf; and approximately 1/4-inch- diameter, stainless-steel rod suspended beneath shelf for drying rags.

I. **Under-Lavatory Guard:** Provide under-lavatory guard where lavatory piping is exposed below the counter or with wall hung lavatories. Under-lavatory Guards to complying with the following
   1. **Basis of Design:** Truebro, Inc.
   2. **Insulating Piping Coverings**: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

J. **Shower Curtain Rod:** Where this designation is indicated, provide stainless-steel shower curtain rod complying with the following:
   1. **Basis of Design:** Bobrick, B-6047 Series, length as indicated on the drawings or if now indicated then length as required for opening.
   2. **Stainless-Steel Nominal Thickness**: Minimum 18-gauge.
   3. **Mounting**: Exposed with manufacturer's standard flanges and anchors.
   4. **Gripping Surfaces**: Smooth, satin finish.
   5. **Outside Diameter**: 1-1/4 inches for heavy-duty applications.

K. **Shower Curtain:** Where this designation is indicated, provide shower curtain complying with the following:
   1. **Shower Curtain**: Water repellent, anti-microbial, 100 percent polyester material with ultrasonic water sheeting bottom hem. Provide with matching “Flex-On” color rings sized for shower curtain rod.
      a. **Size**: Minimum 6 inches wider than opening by 72 inches high.
      b. **Color**: As selected by Architect from manufacturer's full range.
      c. **Quantity**: Provide one (1) shower curtain for each shower as indicated, plus 25 percent extra stock. If less than four (4) curtains are required, no extra stock is required.

d. **Basis of Design:** Litchfield, Hookless Shower Curtain; Arcs & Angles, www.arcsandangles.com.
   1) **Pattern:** 'Plainweave'
   2) **Fabric**: 100% polyester, water repellent with ultrasonically cut bottom hem.
   3) **Size**: As indicated on the Drawings.
   4) **Color**: **White** with chrome rings.

L. **Folding Shower Seat:** Where this designation is indicated, provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:
   1. **Basis of Design:** Bobrick, B-5181.
   2. **Configuration**: L-shaped seat, designed for wheelchair access.
   3. **Seat Material:** Phenolic or polymeric composite of slat-type or one-piece construction. Color as selected by Architect from mfr's full range.

M. **Towel Pin/Robe Hook**: Where this designation is indicated, provide towel pin/robe hook complying with the following:
   1. **Basis of Design**: Amerock, "Arrondi" collection; #BH26542SS
   2. **Single-Pin Unit:** Stainless-steel, single-prong towel pin; 2 inch projection, 2 inch vertical height. Round escutcheon with set screw.

N. **Warm-Air Hand Dryer**: Where this designation is indicated, provide hand dryer complying with the following:
   1. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
      a. **Manufacturer:** Dyson
      b. **Product:** Airblade
   2. **Acceptable Manufacturers:** Subject to compliance with requirements of the Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
      a. **Dyson** B2B, Inc.; www.dysonairblade.com.
      b. **Mitsubishi** Electric; www.mitsubishijettowel.com
   3. **Hand Dryer**: Surface mounted, hygenic, rapid drying hand dryer.
      a. **Warranty Period**: 5 years parts; 1 year labor.
      b. **Controls**: Touch-free infra-red activation. Dry time 12 seconds.
      c. **Motor**: 81,000 rpm digital motor; 110-120V AC, 12 A, 1400 W.
      d. **Cover**: Die-cast aluminum casing with anti-microbial scuff resistant lacquer coating on exterior surfaces
      e. **Finish**: Metallic silver, gloss lacquer.
      f. **Construction:** Polycarbonate-ABS casing with homogenous anti-microbial additive. Anti-microbial integrated external plastics, seals, and air ducts. Tamper-proof T30 type exterior screws. Water ingress protection to IPX5.
      g. **Airspeed at nozzle**: 400 mph
      h. **Operating Airflow**: 68 cfm
      i. **Rated Operating Noise Power**: 84 db(A)
      j. **Filtration**: HEPA filter with anti-microbial coating 99.97% particulate efficiency.

O. **Warm-Air Hair Dryer**: Where this designation is indicated, provide warm-air hair dryer complying with the following:

1. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   a. **Manufacturer:** World Dyer
   b. **Product:** "Airstyle - Model B" (surface mounted)
2. **Acceptable Manufacturers:** Subject to compliance with requirements of the Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and the requirements of Division 1 Sections.
   a. **American** Dryer; www.americandryer.com
   b. **Excel** Dryer; www.exceldryer.com.
   c. **World** Dryer; www.worlddryer.com
3. **Electrical Requirements**:
   a. **Volts**: 115.
   b. **Amps:** 20.
   c. **Watts**: 2300.
   d. **Frequency**: 60 Hz.
4. **Cover**: 14 gauge thick brushed 304 stainless steel.
5. **Motor:** Universal type, 1/10 hp at 7500 RPM.
6. **Air Volume**: 200 CFM of warm air volume.
7. **Control**: Push button control. Timer shall be cam-operated electro-mechanical type, designed to operate the hair dryer for no less than 80 seconds.
8. **Nozzle**: Chrome plated designed to rotate 360 degrees.
9. **Warranty**: 10 year limited.

**END OF SECTION**

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# SECTION 10 4400

# FIRE-PROTECTION SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes:**
   1. **Portable fire extinguishers:**
      a. **Multipurpose dry** chemical type.
   2. Fire-protection **cabinets** for portable fire extinguishers:
   3. **Fire-protection** accessories.

B. **Related Sections** include the following:
   1. **Division 10** Section "**Signs**" for directional signage to out-of-sight fire extinguishers and cabinets.

### 1.3 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
   1. **Fire Extinguishers**: Include rating and classification.
   2. **Cabinets:** Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. **Samples for Selection**: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

### 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. **NFPA Compliance**: Fabricate and label fire extinguishers to comply with **NFPA 10**, "Standard for Portable Fire Extinguishers."

C. **Fire Extinguishers**: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide extinguishers listed and labeled by FM.

### 1.5 COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated, including fire extinguishers provided by Owner under separate contract.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. **Portable Fire Extinguishers**:
   a. **Amerex** Corporation.
   b. **J.L. Industries**, Inc.
   c. **Kidde;** Div. of United Technologies Corporation.
   d. **Larsen's** Manufacturing Company.
   e. **Potter-Roeme**r; Div. of Smith Industries, Inc.
2. **Fire-Protection Cabinets**:
   a. **J.L. Industries**, Inc.
      1) **Basis of Design: Academy Series 1027V10** - Semi-Recessed cabinet with 3 inch deep clear anodized aluminum rolled trim with a contemporary vertical clear acrylic window.
   b. **Larsen's** Manufacturing Company.
   c. **Potter-Roemer;** Div. of Smith Industries, Inc.

### 2.2 MATERIALS

A. **Cold-Rolled Steel Sheet**: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

### 2.3 PORTABLE FIRE EXTINGUISHERS

A. **General**: Provide fire extinguishers as indicated in the Summary above.

B. **Multipurpose Dry-Chemical Type**: UL-rated **4-A:60-B:C, 10-lb** (4.5-kg) nominal capacity, in enameled-steel container.

C. **Coordinate size of portable fire extinguishers with cabinets**. Report discrepancies to Architect prior to ordering units.

### 2.4 FIRE-PROTECTION CABINETS

A. **Cabinet Construction**: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
   1. **Cabinet Metal**: Aluminum sheet.

B. **Cabinet Type**: Suitable for the following:
   1. Fire extinguisher.

C. **Cabinet Mounting**: Suitable for the following mounting conditions:
   1. **Semi-Recessed:** Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated.

D. **Cabinet Trim Style**: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
   1. **Exposed Trim**: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend)
      a. Rolled-Edge Trim: 3 inch (76 mm) backbend depth.

E. **Cabinet Trim Material**: Manufacturer's standard, as follows:
   1. Aluminum sheet.

F. **Door Material**: Manufacturer's standard, as follows:
   1. Aluminum (#180 clear anodized)

G. **Door Glazing**: Manufacturer's standard, as follows:
   1. **Acrylic**: Smooth, as follows:
      a. Thickness: 6 mm.

H. **Door Style**: Manufacturer's standard design, as follows:
   1. Vertical acrylic panel with frame. Roller latch to secure door.

I. **Door Construction**: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
   1. Provide minimum 1/2-inch- (13-mm-) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.

J. **Door Hardware**: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

## 2.5 ACCESSORIES

A. **Mounting Brackets**: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
   1. Provide brackets for extinguishers not located in cabinets.
   2. Provide brackets for extinguishers located in cabinets.

B. **Identification**: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
   1. **Identify bracket-mounted extinguishers** with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
   2. **Identify fire extinguisher in cabinet** with the words "FIRE EXTINGUISHER" applied to door.
      a. **Application Process**: Silk-screened.
      b. **Lettering Color**: Red.
      c. **Orientation**: Vertical.

## 2.6 COLORS AND TEXTURES

A. **Colors and Textures**: As selected by Architect from manufacturer's full range for these characteristics.

## 2.7 FINISHES, GENERAL

A. **Comply with NAAMM's** "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Protect mechanical finishes** on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. **Appearance of Finished Work**: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. **Cabinet and Door Finishes**: Provide manufacturer's standard **baked-enamel paint** for the following:
   1. Interior of cabinets and doors.

## 2.8 ALUMINUM FINISHES

A. **Finish designations** prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes

B. **Class II, Clear Anodic Finish**: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1)

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine walls** and partitions for suitable framing depth and blocking where fully-recessed cabinets are to be installed.

B. **Examine fire extinguishers** for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged units.

C. **Proceed** with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. **Comply** with manufacturer's written instructions for installing fire-protection specialties.

B. **Install in locations** and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
   1. **Prepare recesses** for cabinets as required by type and size of cabinet and trim style.
   2. **Fasten mounting brackets** to structure and cabinets, square and plumb.
   3. **Fasten cabinets to structure**, square and plumb.

## 3.3 ADJUSTING, CLEANING, AND PROTECTION

A. **Adjust** cabinet doors that do not swing or operate freely.

B. **Refinish or replace** cabinets and doors damaged during installation.

C. **Provide final protection** and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

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# SECTION 10 5129

# SOLID PHENOLIC LOCKERS

## PART 1 - GENERAL

### 1.1 RELATED SECTIONS

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

### 1.2 SUMMARY

A. **Solid phenolic** lockers.
   1. **Double tier** lockers: 12 W x 15 D x 30 H inches, 60 inch total height.
   2. **Full height** lockers: 12 W x 15 D x 60 H inches.

B. **Hardware** and accessories

### 1.3 SUBMITTALS

A. **Provide submittals** in accordance with Division 1 Section "Submittals".

B. **Submit shop drawings** showing locker plan layout, numbering plan, profiles, and product components, including anchorage, accessories and finish colors.

C. **Submit product data** on locker construction, hardware, and accessories.

D. **Submit two samples** 4 x 4 inch (100 x 100 mm) in size illustrating finish and color.

E. **Submit maintenance data** for installed products in accordance with provisions in General Requirements issued by Owner .

### 1.4 DELIVERY, STORAGE AND HANDLING

A. **Generally comply** with provisions in General Requirements issued by Owner.

B. **Comply with manufacturer's ordering instructions** and lead time requirements to avoid construction delays.

C. **Deliver materials** in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. **Store lockers indoors**, protected from weather conditions and construction activities.

### 1.5 PROJECT CONDITIONS

A. **Building enclosed**, completely protected from outside weather with minimum inside temperature of 60F.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Accu Tec** Manufacturing, Inc.; www.accutecmfg.com
   2. **ASI** Storage Solutions; www.asilockers.com
   3. **Spec-Rite Designs**, a MHS Legacy Group company; www.specritedesigns.com

### 2.2 MATERIALS

A. **Panel Material:**
   1. Decorative papers impregnated with the melamine resin on faces with a clear protective overcoat and integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
   2. **Core or panel material** shall meet fire resistance per ASTM E84, Class A.
   3. **Colors:**
      a. **Doors and Ancillary Panels:** As selected by Architect from manufacturer's full color range, including extended lead time color collection.
         1) **Black Core**
      b. **Locker Interior:** As selected by Architect from manufacturer's full color range, including extended lead time color collection.
         1) **Black Core**

B. **Doors:**
   1. **Material:** 1/2 inch (13mm) thick solid phenolic composite material.
   2. **Corners:** Rounded
   3. **Edges:** Crescent profile; machine polished and free from tooling imperfections
   4. **Limit Arm:** Provide stainless steel limit arm to allow maximum opening to 90 degrees.
   5. **Door Fastening:** Through Bolted or Blind Fixing, as selected by Architect.

C. **Locker Bodies**: Conceal fasteners to maximum extent possible.
   1. **Exposed edges:** Straight profile; eased edges to remove sharpness; machine polished and free from tooling imperfections.
   2. **Tops, bottoms, and intermediate shelves:** 1/2 inch (13mm) thick solid phenolic composite material with ventilation holes.
   3. **Locker backs:** 1/4 inch (6 mm) thick solid phenolic composite material.
   4. **Locker sides:** 3/8 inch (10 mm) thick solid phenolic composite material.

D. **Ancillary Panels:** Finished end panels and closures shall be 1/2 inch (13mm) thick solid phenolic composite material.

E. **Hardware:**
   1. **Hinges:**
      a. Material: 304-grade stainless steel.
      b. Quantity: Three (3) for full height doors and two (2) for multi-tier units.
   2. **Interior Hooks:**
      a. Material: Stainless Steel.
      b. Top Hook: Two prong: one per opening.
      c. Side Hook: Single prong: two per opening.

3. **Retaining Bar:** Provide stainless steel limit arm opening no more than 90 degrees.
4. **Fasteners:** Exposed fasteners shall be 304 stainless steel.
5. **Fastener Application:** Apply directly into or through the material.
6. **Other Reinforcement:** Aluminum or metal profiles for reinforcements shall not be permitted.

F. **Ventilation:**
1. **Interior Vent:** Provide six 3/8 inch (10mm) diameter ventilation holes on tops, bottoms, and intermediate shelves.

## 2.3 ACCESSORIES AND OPTIONS

A. **Locking System:** Hasp preparation for Owner-furnished padlock.

B. **Locker Top:** Sloped, 1/2 inch (6mm) thick solid phenolic composite material.

C. **Door Identification:** Fonts to be a minimum 1/2 inch high and up to four alphanumeric characters. Numbering sequence to be provided by Architect. Style as selected by Architect from manufacturer's full range.

D. **ADA Accessibility Options:**
1. Shelf kit: Adjust shelf height to meet reach range requirements (no higher than 48 inches AFF for accessible locker).
2. Door Kit: Door kit shall include additional door handle to meet door pull requirements and shall include handicap signage (Routered ADA logo or adhesive backed ADA signage as selected by Architect.
3. Where lockers are provided in accessible spaces, at least five percent (5%) but not less than one (1) of each type of locker shall comply with accessibility guidelines.

## 2.4 FABRICATION

A. **Fabricate lockers** square, rigid and without warp.

B. **Fabricated corners**, fillers, scribes, tops as required for installation.

# PART 3 - EXECUTION

## 3.1 FIELD MEASUREMENT AND VERIFICATION

A. Verify that locker area is ready for installation.
1. Verify **field measurements** are as shown on approved shop drawings.
2. Verify that **bases are properly leveled**, sized and in correct location.
3. Verify correct location of **built-in framing** and **blocking**.

## 3.2 INSTALLATION

A. **Install lockers** at the locations shown in accordance with manufacturer’s instructions for plumb, level, rigid and flush installation.
1. **Fasten locker frames** to each other with chromium plated t-nuts and hex head screws through holes per drilled at factory.

2. **Secure banks** of lockers every 4 feet to walls or wall studs for earthquake resistance with straps as supplied by manufacturer.
3. **Install end and corner fillers** and caps, cut to size in field per plans.
4. **Install end panels**, sloped tops, finish tops.
5. **Install number discs**, clean lockers, remove all related trash and debris from jobsite.

## 3.3 CLEAN UP

A. Upon completion of the work of the work, remove surplus materials, rubbish and debris resulting from the operations under the section, including equipment and implements of service, and leave the entire structure and site insofar as the work of this section concerned in a neat, clean, and acceptable condition.

**END OF SECTION**

# DIVISION 11 - EQUIPMENT


| | |
|---|---|
| Section 11 1413 | Pedestrian Turnstiles |
| Section 11 5213 | Projection Screens |
| Section 11 6113 | Draw Curtain |
| Section 11 9400 | Industrial fans |

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# SECTION 11 1413

# PEDESTRIAN TURNSTILES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Swing gates and pedestals.

### 1.2 REFERENCES

A. **ADAAG** - Americans with Disabilities Act Accessibility Guidelines; U.S. Architectural and Transportation Barriers Compliance Board.

### 1.3 SUBMITTALS

A. Submit under provisions of Division 1 Section "Submittals".

B. **Product Data**: Manufacturer's descriptive literature for equipment specified, including components and accessories.

C. **Shop Drawings**: Indicate location of each individual pedestrian control device in the project.

D. **Verification Samples**: Two samples, minimum size 6 inches, for each color or finish specified.

E. Manufacturer's instructions: Printed installation instructions for each product.

### 1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Sign types to comply with ADAAG requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products of this section in manufacturer's unopened packaging until installation.

B. Maintain dry, heated storage area for products of this section until installation of products.

### 1.6 WARRANTY

A. All Turnstile Security System's products are warranted against defects in material or workmanship for a period of 18 months from date of shipping.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Hayward Turnstiles, Inc.
   2. **Products:** MR-200 ADA and MR-200 pedestals without gate.

B. **Available Manufacturers:** Subject to compliance with requirements of Contract Documents, manufacturers with products which may be incorporated into the Work include, but are not limited to:
   1. **Hayward** Turnstiles, Inc.; www.haywardturnstiles.com
   2. **Magnetic Automation** Corporation; www.gatesandbarriers.com
   3. **Turnstile Security** Systems, Inc.; www.turnstilesecurity.com.

C. Unless otherwise specified for an individual product or material, supply all products specified in this section from the same manufacturer.

### 2.2 MATERIALS AND FINISHES

A. **Construction:**
   1. **Cabinet:** Outer shell and inner shell, 14 gage Type 304 stainless steel with No. 4 finish.
   2. **Top Surface:** Solid surface material, color as selected by Architect from manufacturer's full range.
   3. **Base:** 7 gage Type 304 stainless steel with No. 4 finish.
   4. **Arm:** 1-15/16 inch (33 mm) diameter, 12 gage Type 304 stainless steel with No. 4 finish.
   5. **Hub:** 4-1/2 inch (114 mm) outside diameter, Type 304 stainless steel with No. 4 finish.

B. **Dimensions:**
   1. **Height:** 39 inches (991 mm)
   2. **Depth:** 10-7/8 inches (276 mm)
   3. **Width:** 36-3/4 inches (933 mm).

C. **Control Head:** Self-centering, adjustable hydraulic shock suppression, hardened tool steel Teflon coated locking pawls, hardened tool steel cam and roller assemblies, permanently lubricated bearings.

D. **Keylock:** Control direction of travel manually by key to lock or unlock, or may be used to override electronic controls.

### 2.3 OPERATION

A. **Provide three (3) pedestals** as shown on Drawings: One (1) exit gate with arm and two (2) entry pedestals without gate.

B. **Equip all pedestals** with electrical and data conduit for future card swipe or other control function. Movement on gate at exit shall be free-flow in direction of egress; provide with key lock to lock or unlock or to override future electronic controls.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Verify that surfaces** to receive pedestrian control devices are properly prepared and ready to receive equipment.

B. **Verify wiring and work** provided by others is appropriate for the installation. Notify the Architect if conditions are unsatisfactory.

### 3.2 INSTALLATION

A. **Install pedestrian control devices** in accordance with manufacturer's instructions and the approved shop drawings. Comply with ADA requirements as required.

B. **Prepare surfaces** to assure a smooth, level and rigid surface.

C. **Set fixed equipment with expansion bolts** or other devices in accordance with the approved shop drawing.

D. **Complete wiring** in accordance with the approved shop drawings.

**END OF SECTION**

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# SECTION 11 5213

# PROJECTION SCREENS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** the following:
   1. Front-projection screens, manually and electrically operated.

B. **Related Sections** include the following:
   1. **Division 6** Section "**Miscellaneous Carpentry**" for wood backing for recessed screen installation.
   2. **Division 26** Sections for **electrical service** and connections including metal device boxes for switches and conduit, where required, for low-voltage control wiring.

### 1.3 DEFINITIONS

A. **Gain of Front-Projection Screens**: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. **Half-Gain Angle**: The angle, measured from the axis of the screen surface, to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

### 1.4 SUBMITTALS

A. **Product Data**: For each type of screen indicated.

B. **Shop Drawings**: Show layouts and types of projection screens. Include the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of wiring connections.
   3. Location of seams in viewing surfaces.
   4. Connections to supporting structure for recess-mounted screens.
   5. Anchorage details.
   6. Details of juncture of exposed surfaces with adjacent finishes.
   7. Frame details.
   8. Accessories.
   9. Wiring Diagrams: For electrically operated units.

C. **Samples for Selection**: For finishes of surface-mounted screen cases.

D. **Maintenance Data**: For projection screens to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

A. **Source Limitations**: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. **Electrical Components, Devices, and Accessories**: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

## 1.7 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

# 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. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

## 2.2 FRONT-PROJECTION SCREENS

A. **Manually Operated Screens, General**: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.
   1. **Screen Mounting**: Top edge securely anchored to a 3-inch- diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
   2. **Screen Return**: Equal to:
      a. Da-Lite '**Controlled Screen Return**' (CSR).
      b. Draper '**AutoReturn**'

B. **Electrically Operated Screens, General**: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. **Line Voltage Control**: Remote, key-operated, 3-position control switch installed in recessed metal device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
      a. Provide locking cover plates for switches.

2. **End-Mounted Motor**: Instant-reversing, gear-drive motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment as follows:
   a. On right end of screen, unless otherwise indicated.
3. **Screen Mounting**: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter metal rod with ends of rod protected by plastic caps.
   a. Roller for end-mounted motor supported by self-aligning bearings in brackets.

C. **Concealed-in-Ceiling Screen Cases**: Steel; integral roller brackets; installed with underside flush with ceiling.
1. Door Slat: Self trim; self-closing and -opening.
2. Case Finish: Baked enamel.
3. Case Color: White.
4. End Caps: Steel; finished to match case.

D. **Electrically Operated Screens**:
1. **General**: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. **Line Voltage Control**: Remote, key-operated, 3-position control switch installed in recessed metal device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
3. **Provide locking cover plates** for switches.
4. **End Mounted Motor**: Instant reversing, gear drive motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal overload protection, preset limit switches to automatically stop screen in up and down positions, and positive stop action to prevent coasting.
   a. **Locate motor** in its own compartment on right end of screen, unless otherwise indicated.
5. **Screen Mounting**: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8 inch (9.5 mm ) diameter metal rod with ends of rod protected by plastic caps.
   a. Roller for end mounted motor supported by self aligning bearings in brackets.
6. **Recessed, Electrically Operated Screens with Ceiling Closure**: end mounted motor units with bottom of case equipped with fully automatic closure under screen compartment.
   a. **Available Products**:
      1) **Da-Lite** Screen Co., Inc.; **Boardroom Electrol**.
      2) **Draper** Inc.; **Signature/Series E**.
      3) **Stewart** Filmscreen Corporation; **ABT-4 Trapdoor**.
      4) **Provide metal or metal-lined motor enclosure** on units with end-mounted motor.
   b. **Provide screen case** with trim flange to receive ceiling finish.
   c. **Prime paint surfaces** of screen case that will be exposed to view in the finished work
   d. **Size:** Provide size as indicated on the Drawings or if not indicated provide a minimum of 8'-0" x 10'-0".

E. **Screen Material and Viewing Surface**: (All screen types)

1. **Matte-White Viewing Surface**: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
   a. **Acceptable Products**: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and requirements of Division 1 Sections.
      1) **BEI** Audio/Visual Products - Matte White
      2) **Bretford** Manufacturing, Inc.; - Matte White.
      3) **Da-Lite** Screen Co., Inc.; - Matte White
      4) **Draper** Inc. Fiberglass - Matte White.
      5) **Stewart** Filmscreen Corporation - Matte White
2. **Material**: Vinyl-coated glass-fiber fabric.
3. **Mildew Resistance**: Rating of 0 or 1 when tested according to ASTM G 21.
4. **Flame Resistance**: Passes NFPA 701.
5. **Seams**: Screen are to be **without seams** except where length of screen indicated exceeds maximum length produced without seams in material specified, provide screen with horizontal seam placed as follows:
   a. **At top of screen** at juncture between extra drop length and viewing surface.
6. **Edge Treatment**: Without black masking borders.
7. **Provide extra drop length** of dimension indicated to comply with the following requirements for fabric color and location of drop length:
   a. **Color**: Same as viewing surface.
   b. **Location**: At top of screen.
8. **Size of Viewing Surface**: As indicated for each space.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. **General**: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. **Install front-projection screens with screen cases** in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. **Install low-voltage controls** according to NFPA 70 and manufacturer's written instructions.
   a. **Wiring Method:** Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
2. **Test electrically operated units** to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.
3. **Test manually operated units** to verify that screen operating components are in optimum functioning condition.

## 3.2 PROTECTING AND CLEANING

A. **After installation**, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

**END OF SECTION**

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# SECTION 11 6113

# DRAW CURTAIN

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes** curtain and track system for Group Fitness 203. All necessary items to provide a complete operating system as indicated in the specifications and drawings whether or not specifically mentioned, including but not limited to curtains, curtain tracks and all necessary items for hanging the curtains.

B. **Related Sections** include the following:
1. **Division 5** Section "**Metal Fabrications**" for supplementary metal members supporting curtain systems to structure.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Shop Drawings**: Show fabrication and installation details for stage curtains. Include plans, elevations, sections, details, attachments to other work, and the following:
1. Operating clearances.
2. Requirements for supporting curtains, track, and equipment. Verify capacity of each track and rigging component to support loads.

C. **Samples for Selection**: For each type of stage curtain indicated; include color charts showing the full range of colors, textures, and patterns available, together with a 12-inch-(300-mm-) square sample (any color) of each type fabric.

D. **Qualification Data**: For Installer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. **Maintenance Data**: For stage curtains and rigging to include in maintenance manuals.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: A firm or individual experienced in installing curtains and rigging similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. **Fire-Test-Response Characteristics**: Provide stage curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Flame-Resistance Ratings: NFPA 701.

2. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.

C. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

## 1.5 PROJECT CONDITIONS

A. **Field Measurements**: Verify curtain openings and the dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings.

# PART 2 - PRODUCTS

## 2.1 CURTAIN FABRICS

A. **General**: Provide fabrics inherently and permanently flame resistant or chemically flame resistant by immersion treatment to comply with requirements indicated. Provide fabrics from the same dye lot.

## 2.2 MAIN CURTAIN

A. **Fabric**: 100 percent Polyester IFR Equal to 'Prestige' by Rose Brand.

B. **Fabric Weight**: Fabric weighing not less than 24 oz./ linear yard (775 g/linear meter) with pile height not less than 75 mils (1.9 mm).

C. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. **J. L. de Ball** America, Inc.
2. **KM** Fabrics, Inc.
3. **Rose** Brand
4. **Valley Forge Fabrics**, Inc.

D. **Colors, Textures, and Patterns:** As selected by Architect from manufacturer's full range.

## 2.3 CURTAIN FABRICATION

A. **General**: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams, unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.
1. **Vertical Hems**: Provide vertical hems not less than 2 inches (50 mm) wide, with not less than a 1-inch (25-mm) tuck, and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.
2. **Top Hems**: Reinforce top hems by double-stitching 3-1/2-inch- (89-mm-) wide, heavy jute webbing to top edge with not less than 2 inches (50 mm) of face fabric turned under.

3. **Pleats**: Provide 50 percent fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 3-inch (75-mm) double-stitched box pleats spaced at 12 inches (300 mm) o.c. along top hem reinforcement for the main curtain and 8 inches (200 mm) o.c. for the legs and back panels.
4. **Grommets**: Brass, No. 3, centered on each box pleat and 1 inch (25 mm) from corner of curtain for S-hooks.
5. **Bottom Hems**: For floor-length curtains, provide hems not less than 6 inches (150 mm) deep with 1-inch (25-mm) weight tape or jack chain or weight at each seam. Sew open ends of hems closed.

## 2.4 TRAVELING CURTAIN FABRICATION

A. **General**: Provide a one way track for curtains with a curve at the stacking end as indicated on the Drawings. Provide the following items for the traveling curtain and any other elements as required in order to provide a complete operating curtains.

B. **Heavy-Duty Track System**:
1. **Available Products**: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. **Automatic Devices** Company.
   b. **H & H** Specialties, Inc.;
      1) Basis of Design: 300 series.
   c. **Tru-Roll**, Inc.

C. Provide the following items for the traveling curtain and any other elements as required in order to provide a complete and operating travel curtain:
1. **Pulley System**: Equip track with heavy-duty, live-end, double-wheel pulley; heavy-duty, dead-end, single-wheel pulley; and adjustable, heavy-duty floor block; each with not less than 5-inch (125-mm) molded-nylon- or glass-filled-nylon-tired ball-bearing wheels, enclosed in steel housings. Design adjustable floor block to maintain proper tension on operating line. Supply adequate double and single spindles and outside idlers to keep the rope tight around the curve.
2. **Carriers**: H & H No. 201 Black Single Carriers. Carriers to have 2 polyethylene wheels riveted to black super tough nylon body with shielded ball bearing, heavy-duty hook, swivel and trim chain for curtain attachment. Each carrier to have 1 rubber bumper. Space carriers at 12 inches along the.
3. **Carrier Accessories and Curtain Attachment**: Equip carriers with neoprene or rubber bumper to reduce noise, and heavy-duty, plated-steel swivel eye and manufacturer's standard trim chain for attaching S-hook. Provide end stops for track.
4. **Operating Line**: Manufacturer's standard 3/8-inch (9-mm) stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear, center filaments. Color to be Black.
5. **Curtain Carriers**: For track spaced at 12 inches (300 mm) o.c.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine areas and conditions**, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage-curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.

B. **Examine inserts, clips, blocking, or other supports** required to be installed by others to support tracks and battens. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION, GENERAL

A. Install curtain system according to track manufacturer's and curtain fabricator's written instructions.

## 3.3 TRACK INSTALLATION

A. **Track Mounting**: Install tracks by suspending from roof structure above. Attach track according to manufacturer's written instructions. Attach to the top chord of roof or floor trusses or top flange of beam. If battens are used, they must be mounted above the lay-in ceiling.

B. **Spacing**: Do not exceed 6' - 0" supports.

## 3.4 CURTAIN INSTALLATION

A. **Track Hung**: Secure curtains to track carriers with track manufacturer's special heavy-duty S-hooks.

**END OF SECTION**

# SECTION 11 9400

# INDUSTRIAL FANS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes:**
   1. Industrial **ceiling mounted fan**s.

B. **Related Sections:**
   1. **Division 23** sections for fans incorporated in mechanical equipment.
   2. **Division 26** sections for wiring and controlling ceiling and wall mounted fans.

### 1.3 SUBMITTALS

A. **Product Data:** For each type of equipment specified, with installation instructions for each unit built-in or connected to other construction. Include methods of installation for each type of substrate.

B. **Shop Drawings:** Showing installation details of equipment permanently affixed to construction, including full scale installation details of special conditions.

### 1.4 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

B. **Single Source Responsibility:** Provide material produced by a single manufacturer for each accessory type.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. **Deliver equipment** to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.

B. **Comply with instructions** and recommendations of manufacturer for special delivery, storage, and handling requirements.

## 1.6 SEQUENCE AND SCHEDULING

A. **Sequence equipment installation** with other work to minimize possibility of damage and soiling during remainder of construction period.

## 1.7 MAINTENANCE

A. **Maintenance Instructions:** Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and method which may be detrimental to finishes and performance.

# PART 2 - PRODUCTS

## 2.1 CEILING MOUNTED FANS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** Modern Fan Company; www.modernfan.com
   2. **Product:** "Pensi", model PEN-AA50ALNL001/009B (Confirm need for multiple switching with electrical drawings).

B. **Provide fans with the following features:**
   1. Pendant style, brushed aluminum body and blades and black ("anthracite") stem, 50- inch blade span, no light, overall length as determined by Architect.
      a. Performance: Airflow - 7345 cubic feet/minute; electricity use - 86W.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. **Verify** that materials are those specified and approved before installing. Verify switching and other controls before proceeding.

B. **Install equipment after** other finishing operations, including painting, have been completed.

C. **Permanently Placed Equipment and Components**: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with room layout.

D. **Anchoring to In-Place Construction:** Use anchors and fasteners where necessary for securing built-in and permanently placed equipment and components to structural support and for properly transferring load to in-place construction.

E. **Coordinate power and control systems for fans.** All conduit and cords shall be concealed.

F. **Adjust equipment items for proper operation**. Clean and polish exposed surfaces, using materials and methods recommended by the manufacturer.

## 3.2 PROTECTION

A. **Protect equipment** against damage during remainder of construction period, complying with manufacturer's directions.

**END OF SECTION**

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# DIVISION 12 - FURNISHINGS


| | |
|---|---|
| Section 12 2400 | Roller Shades |
| Section 12 4815 | Recessed Entry Mats |
| Section 12 9000 | Building Accessories |
| Section 12 9314 | Bicycle Lockers |

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# SECTION 12 2400

# ROLLER SHADES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes**:
1. **Manually** operated roller shades.
2. **Motor-**operated roller shades.

B. **Related Sections** include the following:
1. **Division 6** Section "**Miscellaneous Carpentry**" for wood blocking and grounds for mounting roller shades and accessories.
2. **Division 26** Sections for **electrical service** and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

### 1.3 SUBMITTALS

A. **Product Data**: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
1. **Motorized Shade Operators**: Include operating instructions.
2. **Motors**: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. **Shop Drawings**: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.
1. **Motorized Shade Operators**: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. **Wiring Diagrams**: Power, system, and control wiring.

C. **Samples for Verification**:
1. For the following products:
   a. **Shade Material**: Not less than 3 inches (80 mm) square, with specified treatments applied. Mark face of material.
   b. **Color Selection**: Include similar Samples of accessories involving color selection.

D. **Product Certificates**: For each type of roller shade product, signed by product manufacturer.

E. **Product Test Reports**: For each type of roller shade product.

F. **Qualification Data**: For Installer.

G. **Maintenance Data**: For roller shades to include in maintenance manuals. Include the following:
1. **Methods** for maintaining roller shades and finishes.
2. **Precautions** about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. **Operating** hardware.
4. **Motorized** shade operator.

## 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Source Limitations**: Obtain roller shades through one source from a single manufacturer.

C. **Fire-Test-Response Characteristics**: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. **Flame-Resistance Ratings**: Passes NFPA 701.

D. **Electrical Components, Devices, and Accessories**: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. **Corded Window Covering Product Standard**: Provide roller shades complying with WCMA A 100.1.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

## 1.6 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. **Field Measurements**: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Acceptable Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
   1. **Draper**, Inc.; www.draperinc.com
   2. **SKYCO** Shading Systems, Inc.; www.skycoshade.com
   3. **Mariak;** www.mariak.com.
   4. **MechoShade Systems, Inc.;** www.mechosystems.com
   5. **Nysan** Solar Control Inc., a Hunter Douglas Company; www.nysan.com

### 2.2 ROLLER SHADES

A. **Shade Band Material**: PVC-coated polyester.
   1. **Material Width**: Not less than 60 inches (1520 mm).
   2. **Bottom Hem**: Straight.
   3. **Trim**: As indicated by manufacturer's designation for style and color.
   4. **Material Openness Factor**: Not less than 5%
      a. Equal to Draper PW3500.
   5. **Material Color**: As selected by Architect from manufacturer's full range.

B. **Rollers**: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.

C. **Direction of Roll**: Regular, from back of roller.

D. **Mounting Brackets**: Galvanized or zinc-plated steel.

E. **Fascia**: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings; removable design for access.

F. **Top/Back Cover**: L shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.

G. **Bottom Bar**: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

H. **Shade Operation**: **Manual**; with continuous loop bead chain, clutch, and cord tensioner and bracket lift operator.
   1. **Position of Clutch Operator**: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
   2. **Clutch**: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
   3. **Loop Length**: Length required to make operation convenient from floor level.
   4. **Bead Chain**: Nickel-plated metal.

5. **Cord Tensioner Mounting**: Sill.
6. **Operating Function**: Stop and hold shade at any position in ascending or descending travel.

I. **Shade Operation**: Motorized operator.

J. **Mounting**: Bottom-up brackets mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

K. **Hold-Down Brackets and Hooks or Pins and Side Channels**: Provide manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are **not mounted vertically** but are at an angle or other conditions where light gaps could occur.

## 2.3 ROLLER SHADE FABRICATION

A. **Product Description**: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. **Concealed Components**: Noncorrodible or corrosion-resistant-coated materials.
1. Lifting Mechanism: With permanently lubricated moving parts.

C. **Unit Sizes**: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
1. **Shade Units Installed between (Inside) Jambs**: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. **Shade Units Installed Outside Jambs**: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. **Installation Brackets**: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. **Installation Fasteners**: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. **Color-Coated Finish**: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. **Colors of Metal and Plastic Components Exposed to View**: As selected by Architect from manufacturer's full range, unless otherwise indicated.

## 2.4 MOTORIZED ROLLER SHADE OPERATORS

A. **General**: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.

B. **Standards**: Comply with NFPA 70.

C. **Control Equipment**: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

D. **Electric Motors**: UL-approved or -recognized, asynchronous, totally enclosed, insulated, capacitor-start motors, complying with NEMA MG 1, with thermal overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
   1. **Service Factor**: According to NEMA MG 1, unless otherwise indicated.
   2. **Motor Characteristics**: Single phase, 110 V, 60 Hz.
   3. **Motor Mounting**: Within manufacturer's standard roller enclosure.

E. **Position of Motor and Electrical Connection**: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.

F. **Remote Controls**: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:
   1. **Control Stations**: Maintained-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions.
      a. **Color**: White.
   2. **Group Control Stations**: Maintained-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control.
      a. **Color**: White.

G. **Limit Switches**: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

H. **Operating Function**: Stop and hold shade at any position.

I. **Operating Features**: Include the following:
   1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine substrates**, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ROLLER SHADE INSTALLATION

A. **Install roller shades level**, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

B. **Connections**: Connect motorized operators to building electrical system.

C. **Horizontal installations**: Install roller shades horizontally where indicated on the drawings.

### 3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

### 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Division 1 Section "Closeout Procedures."

**END OF SECTION**

# SECTION 12 4810

# CARPET TYPE MATS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Carpet-type** mats.

B. **Related Sections** include the following:.
   1. **Division 9** Section "**Carpet**" for tufted and woven carpet and cushions.

### 1.3 SUBMITTALS

A. **Product Data**: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat and frame specified.

B. **Samples for Selection**: For each type of floor mat and frame indicated.

C. **Maintenance Data**: For cleaning and maintaining floor mats to include in maintenance manuals.

### 1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain floor mats and frames through one source from a single manufacturer.

B. **Accessibility Requirements**: In addition to requirements of authorities having jurisdiction, provide installed floor mats that comply with Sections 302 and 303 in ICC A117.1.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer:** J & J Invision
   2. **Product:** Catwalk Modular 7010.

B. **Acceptable Manufacturers**: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below. If not listed, submit as a substitution according to the Conditions of the Contract and requirements of Division 1 Sections.
   1. **J & J Invision.**
   2. **Lees** Commercial Division
   3. **Mannington** Commercial.
   4. **Tandus**.

## 2.2 FLOOR MATS

A. **General**: Provide colors & patterns as indicated in the **Finish Schedule**.

B. **Carpet-Type Mats**: Nylon carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with non-raveling edges.
   1. **Construction**: Textured Patterned Loop
   2. **Gauge**: 1/8 inch.
   3. **Stitches**: 9.5 per inch.
   4. **Face Yarn**: Encore SD.
   5. **Dye Method**: Solution dyed.
   6. **Face Weight**: 34 oz/square yard.
   7. **Size**: 24 x 24 inches.
   8. **Fiber Technology**: "ProTex" soil release.
   9. **Backing Material**: "Nexus" modular.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. **Examine substrates**, and floor conditions for compliance with requirements for location, sizes and other conditions affecting installation of floor mats and frames.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PROTECTION

A. **Defer installation of floor mats** until Project is near Substantial Completion.

**END OF SECTION**

# SECTION 12 9000

# BUILDING ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **section includes** the following:
   1. **Flat panel** wall television mounts.
   2. **Video projector** mounts.

### 1.3 SUBMITTALS

A. **Product data** for each type of accessory specified, with installation instructions for each unit built-in or connected to other construction. Include methods of installation for each type of substrate.

B. **Shop drawings** showing installation details of accessories permanently affixed to construction, including full scale installation details of special conditions.

C. **Samples for initial selection** purposes consisting of manufacturer's standard size samples showing full range of colors, textures, and patterns available for each type of accessory required.

### 1.4 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

B. **Single Source Responsibility**: Provide material produced by a single manufacturer for each accessory type.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

## 1.6 SEQUENCE AND SCHEDULING

A. Sequence accessory installation with other work to minimize possibility of damage and soiling during remainder of construction period.

## 1.7 MAINTENANCE

A. **Maintenance Instructions**: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and method which may be detrimental to finishes and performance.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

A. **Fasteners**: Screws, bolts or other exposed devices of same material as accessory unit, or of galvanized steel where concealed. Equip items with theft-proof fasteners where accessible to tampering.

## 2.2 FABRICATION, GENERAL

A. Provide accessory items, permanently installed, equipped with functions as specified. Fabricate units with tight seams and joints, exposed metal edges rolled. Manufacturer or product identification on exposed surfaces is unacceptable. Provide products with smooth welds, consistent finish with no evidence of wrinkling, chipping, uneven coloration, dents, or other imperfections.

## 2.3 FLAT PANELTELEVISION MOUNTS

A. Equal to **Da-Lite/Advance Articulating Flat Panel** Wall Mount **Model PWM-AR1** and shall be mounted where **indicated on plans** or if not indicated then as directed by the Architect. The mount shall be equipped with an articulating arm that can extend a flat panel monitor up to 29” away from the wall. The mount will hold up to 130 lbs. and should be capable of 20 degrees of tilt. Finish: **Black powder coat** with a **five (5) year warranty**.

## 2.4 VIDEO PROJECTOR MOUNTS

A. **Suspended Ceiling Kit**: Provide ceiling kit designed for mounting LCD/DLP projectors weighting less than **50 pounds**. Projector mounts shall be of all steel construction using National Pipe Thread (NPT) and American National Standards Institute (ANSI) Society of Automotive Engineers (SAE) and metric materials. Kits shall have all parts and accessories to provide a complete and workable installation.

1. **Available Manufacturers** include but are not limited to:
   a. **Peerless** Industries, Inc.; www.peerlessmounts.com.
   b. **Chief** Manufacturing; www.chiefmfg.com
2. **Suspended Ceiling Kit**:
   a. **Basis of Design**: **'Chief'** Model no. **CMA-440/RPA-U/CMA-003**.
   b. Kit shall consist of an 8" x 24" reinforcing plate.
   c. Safety cable.
   d. Strand wire.
   e. Outlet knockouts.
   f. Turnbuckles, bolts, anchors.

g. Chrome ceiling ring.
h. Reinforcing plate shall allow for infinite adjustment.
i. **Color**: **Black**.

3. **Universal Inverted Projector Ceiling Mount**: Equal to **'Chief'** model # **RPA-U**.
   a. **Basis of Design**: **'Chief'** model **# RPA-U**.
   b. **Dynamically adjustable** mounting legs.
   c. **Color: Black**.
4. **Fixed Extension Column**:
   a. **Basis of Design**: **'Chief'** model **# CMS**
   b. Length of extension to be such that projector is below hanging light fixtures.
5. **Provide** one (1) suspended ceiling kit wherever a projector is indicated or scheduled on the drawings, but **as a minimum provide one mount per classroom**.
6. **Provide** with **five (5) year** parts and labor warranty.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. **Verify** that materials are those specified before installing.

B. **Install accessories** after other finishing operations, including painting, have been completed.

C. **Permanently Placed Equipment and Components**: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with room layout.

D. **Anchoring to In-Place Construction**: Use anchors and fasteners where necessary for securing built-in and permanently placed equipment and components to structural support and for properly transferring load to in-place construction.

E. **Adjust accessory items** for proper operation. Clean and polish exposed surfaces, using materials and methods recommended by the manufacturer.

### 3.2 PROTECTION

A. **Protect accessories** against damage during remainder of construction period, complying with manufacturer's directions.

**END OF SECTION**

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# SECTION 12 9314

# BICYCLE LOCKERS AND RACKS

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Bicycle lockers and serpentine bicycle racks.

### 1.2 RELATED REQUIREMENTS

A. Division 3 Section "Cast-in-Place Concrete" for mounting surface for bicycle lockers.

### 1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

### 1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. **Product Data**: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. **Shop Drawings:** Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

D. **Selection Samples**: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle lockers with sufficient care to prevent scratches and other damage to the finish.

## PART 2 PRODUCTS

### 2.1 AVAILABLE MANUFACTURERS

A. **Bicycle Lockers and Racks:** Subject to compliance with requirements of Contract Documents, manufacturers with products that may be incorporated into the Work include, but are not limited to, the following:
1. **Columbia Cascade** Company: www.timberform.com.
2. **Creative Pipe**, Inc: www.creativepipe.com.
3. **Dura** Bike Locker Co.: www.durabikelocker.com
4. **Huntco** Supply, LLC: www.huntco.com.

## 2.2 BICYCLE LOCKERS

A. **Steel Bicycle Lockers:** Secure storage enclosure fabricated of steel panels with factory applied finish and factory installed hardware.
   1. **Capacity**: 2 bicycles per unit.
   2. **Layout:** Horizontal.
   3. **Panels**: 12 gauge, 0.1046 inch (2.657 mm) steel sheet, with manufacturer's standard perforations.
   4. **Interior Partition**: Steel with manufacturer's standard perforations.
   5. **Door and Frame**: Same material as panels; 12 gauge (0.0146 inch) (2.657 mm) minimum frame, door factory hung and adjusted.
   6. **Hardware:**
      a. Door Hinges: Full length, piano type hinges of 14 gauge, 0.0747 inch (1.897 mm) stainless steel.
      b. Locking Mechanism: Steel vertical locking bar running full length of door.
      c. Lock Hardware: Manufacturer's standard stainless steel pistol grip style handle with "U" style lock and padlock adapter.
   7. **Mounting, Ground**: Leveling and anchoring system consisting of feet adjustable up to 5 inches (127 mm) vertically and flanges suitable for bolts or post-installed anchors..
   8. **Finish:** Powder coat, factory applied over primer.
   9. **Color**: As selected by Architect from manufacturer's complete range.
   10. **Quantity:** As shown on Drawings, but not less than 6 units (12 bicycle total capacity).

B. **Materials:**
   1. Bar, Round and Flat, Carbon Steel, ASTM A36.
   2. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating.

## 2.3 BICYCLE RACKS

A. **Exterior Bicycle Racks:** Device allows user provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. **Style**: Serpentine rack formed from a continuous round pipe.
   2. **Capacity:12** bicycles.
   3. **Mounting**, Ground: In-ground anchor.
   4. **Finish:** Powder coat, maintenance-free and weather-resistant.
   5. **Color:** As selected by Architect from manufacturer's complete range.
   6. **Accessories:** In-ground grout cover.

B. **Material:**
   1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. **Examine surfaces** to receive bicycle lockers and racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

## 3.2 PREPARATION

A. **Ensure surfaces** to receive bicycle lockers and racks are clean, flat, and level.

## 3.3 INSTALLATION

A. **Install in accordance** with manufacturer's instructions.

B. **Install bicycle lockers and racks level, plumb, square, and correctly located** as indicated on the Drawings.

## 3.4 CLEANING

A. **Clean installed work** to like-new condition. Do not use cleaning materials or methods that could damage finish.

## 3.5 PROTECTION

A. **Protect installed products** until completion of project.

B. **Touch-up, repair or replace damaged products** before Substantial Completion.

**END OF SECTION**

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# DIVISION 13 - SPECIAL CONSTRUCTION

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# DIVISION 14 – CONVEYING SYSTEMS

Section 14 2400 Hydraulic Elevators

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# SECTION 14 2400

# HYDRAULIC ELEVATORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This **Section includes hydraulic passenger** elevators.

B. **Related Sections** include the following:
1. **Division 3** Section "**Cast-in-Place Concrete**" for setting sleeves, inserts, and anchoring devices in concrete.
2. **Division 4** Section "**Unit Masonry Assemblies**" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
3. **Division 5** Section "**Structural Steel**" for the following:
   a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
   b. Hoist beams.
   c. Structural-steel shapes for subsills that are part of steel frame.
4. **Division 5** Section "**Metal Fabrications**" for the following:
   a. Pit ladders.
5. **Division 9** Section "**Gypsum Board Shaft-Wall Assemblies**" for shaft enclosure.
6. **Division 9** Sections "**Ceramic Tile**" for finish flooring in elevator car.
7. **Electrical Sections** for electrical service for elevators to and including disconnect switches at machine room door.
8. **Electrical Sections** "Voice and Data Communication Cabling" for telephone service to elevators.

### 1.3 DEFINITIONS

A. **Definitions in ASME A17.1 apply** to work of this Section.

B. **Defective Elevator Work**: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

### 1.4 SUBMITTALS

A. **Product Data**: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
1. Car enclosures and hoistway entrances.
2. Operation, control, and signal systems.

B. **Shop Drawings**: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. **Samples for Selection**: For finishes involving color selection.

D. **Manufacturer Certificates**: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. **Qualification Data**: For Installer.

F. **Operation and Maintenance Data**: For elevators to include in emergency, operation, and maintenance manuals.

G. **Inspection and Acceptance Certificates and Operating Permits**: As required by authorities having jurisdiction for normal, unrestricted elevator use.

H. **Warranty**: Special warranty specified in this Section.

I. **Continuing Maintenance Proposal**: Service agreement specified in this Section.

## 1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. **Source Limitations**: Obtain elevators through one source from a single manufacturer.
   1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. **Regulatory Requirements**: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
   1. Effective peak velocity acceleration (Av) for Project's location is greater than or equal to 0.20 (seismic risk zones 3 and 4).
   2. Project's seismic design category is C.
   3. Elevator importance factor is 1.0.

D. **Accessibility Requirements**: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and 407 in ICC A117.1.

E. **Fire-Rated Hoistway Entrance Assemblies**: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

## 1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

## 1.8 WARRANTY

A. **Special Manufacturer's Warranty**: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
   1. Warranty Period: One year from date of Substantial Completion.

## 1.9 MAINTENANCE SERVICE

A. **Initial Maintenance Service**: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   1. Perform maintenance, including emergency callback service, during normal working hours.
   2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
      a. Response Time: Two hours or less.

B. **Continuing Maintenance Proposal**: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **KONE** Inc.
   2. **Otis** Elevator Co.
   3. **Schindler** Elevator Corp.
   4. **ThyssenKrupp** Elevator.

### 2.2 SYSTEMS AND COMPONENTS

A. **General**: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard pre-engineered elevator systems and as required for complete system.

B. **Pump Units**: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:
   1. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
   2. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
   3. Provide motor with wye-delta or solid-state starting.
   4. Provide variable-voltage variable-frequency motor control.

C. **Hydraulic Silencers**: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

D. **Piping**: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
   1. Provide dielectric couplings at cylinder units.
   2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

E. **Hydraulic Fluid**: Nontoxic, readily biodegradable, fire-resistant fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid shall be approved by elevator manufacturer for use with elevator equipment.
   1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.

F. **Inserts**: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

G. **Car Frame and Platform**: Welded steel units.

H. **Guides**: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

## 2.3 OPERATION SYSTEMS

A. **General**: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.

B. **Single-Car Auxiliary Operations**: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. **Standby-Powered Lowering:** On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel. Manual operation causes automatic operation to cease.
2. **Automatic Dispatching of Loaded Car:** When car load exceeds 80 percent of rated capacity, doors will begin closing.

C. **Controllers:** Provide the Owner with any proprietary controller diagnostic equipment that may be required to communicate with and analyze controller and machinery operations. Instructions and set-up requirements shall be made available for use by others who may be employed by the Owner to monitor elevator operations and maintenance at a later date.

## 2.4 DOOR REOPENING DEVICES

A. **Infrared Array**: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

B. **Nudging Feature**: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.5 FINISH MATERIALS

A. **General**: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. **Cold-Rolled Steel Sheet**: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. **Hot-Rolled Steel Sheet**: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. **Stainless-Steel Sheet**: ASTM A 240/A 240M, Type 304.

E. **Stainless-Steel Tubing**: ASTM A 554, Grade MT 304.

F. **Nickel Silver Extrusions**: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

G. **Plastic Laminate**: High-pressure type complying with NEMA LD 3, Type HGS for flat applications and Type BKV for panel backing.

## 2.6 CAR ENCLOSURES

A. **General**: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.
   1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
   2. Provide finished car including materials and finishes specified below.

B. **Materials and Finishes**: Provide manufacturer's standards, but not less than the following:
   1. **Subfloor**: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
   2. **Floor Finish**: Specified in a Division 9 Section.
   3. **Enameled-Steel Wall Panels**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
   4. **Plastic-Laminate Wall Panels**: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
   5. Fabricate car with recesses and cutouts for signal equipment.
   6. Fabricate car door frame integrally with front wall of car.
   7. **Stainless-Steel Doors**: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
   8. **Sight Guards**: Provide sight guards on car doors.
   9. **Sills**: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
   10. **Ceiling**: Stainless steel with downlights.
   11. **Handrails**: Manufacturer's standard handrails, of shape, metal, and finish indicated.

## 2.7 HOISTWAY ENTRANCES

A. **General**: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
   1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. **Materials and Fabrication**: Provide manufacturer's standards, but not less than the following:
   1. **Stainless-Steel Frames**: Formed from stainless-steel sheet.
   2. **Stainless-Steel Doors**: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
   3. **Sight Guards**: Provide sight guards on doors matching door edges.
   4. **Sills**: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.

5. **Nonshrink, Nonmetallic Grout**: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

## 2.8 SIGNAL EQUIPMENT

A. **General**: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.

B. **Car Control Stations**: Provide manufacturer's standard fully recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. **Emergency Communication System**: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System shall be contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. **Firefighters' Two-Way Telephone Communication Service**: Provide telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Digital, Addressable Fire Alarm."

E. **Car Position Indicator**: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
1. Include travel direction arrows if not provided in car control station.

F. **Hall Push-Button Stations**: Provide one hall push-button station at each landing.
1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

G. **Hall Lanterns**: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

H. **Hall Annunciator**: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
1. At manufacturer's option, audible signals may be placed on car.

I. **Hall Position Indicators**: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

J. **Corridor Call Station Pictograph Signs**: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

K. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal where indicated. Adjacent to switches, provide illuminated signal that indicates when normal and when it is at the designated emergency return level with doors open.

## 2.9 ELEVATORS

A. **Elevator Description**:
1. **Basis of Design: ThyssenKrupp Elevator, Kingswood 40**.
2. **Type**: In-ground jack
3. **Rated Load**: 4000 lb (1814 kg).
4. **Rated Speed:** 200 fpm (1.0 m/s).
5. **Operation System**: Single automatic operation.
6. **Auxiliary Operations**:
   a. Standby-powered lowering.
   b. Automatic dispatching of loaded car.
   c. Nuisance call cancel.
7. **Security Features**: Keyswitch operation.
8. **Car Enclosures**:
   a. **Inside Width**: 92 inches (2337 mm) from side wall to side wall.
   b. **Inside Depth**: 65 inches (1651 mm) from back wall to front wall (return panels).
   c. **Inside Height**: 95 inches (2413 mm) to underside of ceiling.
   d. **Front Walls** (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
   e. **Car Fixtures**: Satin stainless steel, No. 4 finish.
   f. **Side and Rear Wall Panels**: Plastic laminate.
   g. **Reveals**: Satin stainless steel, No. 4 finish.
   h. **Door Faces** (Interior): Satin stainless steel, No. 4 finish.
   i. **Door Sills**: Nickel silver, polished.
   j. **Ceiling**: Six halogen downlights; stainless steel with No. 4 finish.
   k. **Handrails**: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides and rear of car.
   l. **Floor prepared to receive ceramic tile** (specified in Division 9 Section "Ceramic Tile").
9. **Hoistway Entrances**:
   a. **Width**: 48 inches (1219 mm).
   b. **Height:** 84 inches (2134 mm).
   c. **Type**: Two-speed side sliding.
   d. **Fire-Protection Rating**: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
   e. **Frames:** Satin stainless steel, No. 4 finish.
   f. **Doors:** Satin stainless steel, No. 4 finish.
   g. **Sills**: Nickel silver, polished.
10. **Hall Fixtures**: Satin stainless steel, No. 4 finish.

11. **Additional Requirements**:
    a. **Provide inspection certificate** in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
    b. **Provide blanket hooks and** one complete set of full-height protective **blankets.**
    c. **Provide emergency generator operation**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. **Examine elevator areas**, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
   1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. **Install cylinder plumb** and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. **Welded Construction**: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. **Sound Isolation**: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

D. **Install piping above the floor**, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

E. **Lubricate operating parts** of systems as recommended by manufacturers.

F. **Alignment**: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. **Leveling Tolerance**: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.

H. **Set sills flush** with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. **Locate hall signal** equipment for elevators as follows, unless otherwise indicated:
   1. Locate hall push-button station at location most convenient for approaching passengers.
   2. Place hall lanterns either above or beside each hoistway entrance.
   3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

## 3.3 FIELD QUALITY CONTROL

A. **Acceptance Testing**: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. **Advise Owner, Architect, and authorities** having jurisdiction in advance of dates and times tests are to be performed on elevators.

## 3.4 PROTECTION

A. **Temporary Use**: Comply with the following requirements for each elevator used for construction purposes:
   1. **Provide car with temporary enclosure**, either within finished car or in place of finished car, to protect finishes from damage.
   2. **Provide strippable protective film** on entrance and car doors and frames.
   3. **Provide padded wood bumpers** on entrance door frames covering jambs and frame faces.
   4. **Provide other protective coverings**, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
   5. **Do not load elevators** beyond their rated weight capacity.
   6. **Engage elevator Installer** to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   7. **Engage elevator Installer to restore damaged work**, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

## 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 1 Section "Demonstration and Training." Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program.

B. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

**END OF SECTION**

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WEBER STATE UNIVERSITY

# STUDENT ACTIVITY CENTER ADDITION TO THE STROMBERG ATHLETIC COMPLEX

OGDEN, UTAH

OWNER

THE STATE OF UTAH
DIVISION OF FACILITIES AND CONSTRUCTION MANAGEMENT
4110 STATE OFFICE BUILDING
SALT LAKE CITY, UTAH

# BID SET

## VOLUME 2

DIVISIONS 21 THRU 33

03 OCTOBER 2012

VCBO ARCHITECTURE
524 SOUTH 600 EAST
SALT LAKE CITY
UTAH 84102
TEL 801 575 8800
FAX 801 531 9850

## PROJECT MANUAL

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# SECTION 21 1000

# FIRE PROTECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Connections and Fees.

B. Firelines, Extensions as shown on Drawings.

C. System Design Requirements per Jurisdictional Authorities.

D. Interior and Exterior above Ground Piping.

E. Sprinkler System.

F. Fire Department Connections.

G. All Alarms, Switches and Required Wiring.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. The 211000 Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete sprinkler system ready for operation in accordance with the requirements of the authority having jurisdiction. The purpose of the furnished specifications and associated drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust and make operable. The Contractor shall visit the site before submitting the bid, and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of discrepancy or lack of clarity shall be promptly identified to the Owner's Representative and Engineer for clarification.

### 1.3 RELATED SECTIONS

A. Section 012300 - Alternates.

B. Section 230529 - Basic Mechanical Materials and Methods.

C. Section 230540 - Mechanical Sound and Vibration Control.

D. Section 221411 - Disinfecting Water Supply System.

E. Section 221430 - Plumbing Specialties: Pressure gauges, air gap fittings, pressure relief valves.

## 1.4 FIRE LINES

A. The work of this section shall include extension of service mains from the existing utility mains to the new building.

## 1.5 CONNECTIONS AND FEES

A. System development charges and or similar charges, that in principle allow the right to obtain the services from the utility will be arranged and paid for by the 211000 Contractor.

B. Tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the 211000 Contractor.

C. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the 211000 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the 211000 Contractor.

D. Be responsible for all pads, vaults, manholes, manhole covers, valve enclosures, valves, services boxes, and required material, all in conformance with requirements of the serving utility company.

E. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.

F. Permit fees shall be provided in the base bid. The 211000 Contractor shall furnish the Owner with a copy of all official documents and written correspondence associated with permits.

## 1.6 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. – FM Global or Factory Mutual Research.
3. IRI - Industrial Risk Insurors (aka: F.I.A. Factory Insurance Association.)
4. NFPA - National Fire Protection Association.
5. Jurisdictional Agencies:

    a. Building Department.
    b. Fire Department or Fire Prevention Bureau or Marshal.
    c. Insurance Agency, Carrier, and/or Underwriter as defined in Section 1.7.

6. Engineer refers to the consulting Mechanical Engineer of record.
7. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
8. Other definitions for fire protection systems are listed in NFPA 13.
9. Working Plans as used in this Section mean those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.

10. Review and Approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

## 1.7 SYSTEM DESIGN REQUIREMENTS

A. Sprinkler System Requirements:

1. Provide a freeze-protected sprinkler system using dry sprinkler heads to protect under raised portion of building, vestibules, entry canopy, air handler outside air plenum, air handler mixed air plenum, and similar areas subject to freezing.
2. Provide a wet pipe sprinkler system from extension & modification of existing fire riser to protect all other areas of the addition. Include protection of elevator shafts, boiler rooms, refrigeration machinery rooms, and similar areas as required by code.
3. Sprinkler heads shall be centered in ceiling tiles in all finished areas.
4. Provide inspector test valve and piped drain at each riser.

B. Occupancy hazard classifications shall be determined in accordance with NFPA 13 unless higher hazard classifications are indicated on the drawings or required by insurance underwriter or jurisdictional authority.

C. Fire protection shall be designed and installed per NFPA 13 and NFPA 14 FM Global current published standards and local Jurisdictional Agency requirements. Where a conflict occurs the more stringent standard shall apply.

D. Verify requirements with Jurisdictional authorities, i.e.: Insurance Co. or Underwriter (when specified above), Fire Department or Marshal, or Building Department. Provide system complete, functional and acceptable to Jurisdictions without penalty of any type to the insurance premium rate. Division 211000 Contractor shall coordinate his work with all other sections of these specifications and drawings. No change order will be issued for lack of coordination or lack of verification of requirements of Jurisdictional Authorities.

E. System shall be hydraulically calculated per Jurisdictional Agency Standards.

F. All calculations shall include flow test results. Flow tests shall be performed by this Contractor and submitted to the Fire Department. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.

G. The system shall be designed to account for seasonal changes and for future degradation of the water supply system, using previous seasonal flow tests from the water utility to determine the expected range of pressure fluctuation at the project site.

H. Be responsible for accurate measurements, coordination with other trades, required offsets, scheduling, timely submittals, material delivery, job manning, and conformance to construction schedules.

I. All areas shall be classified in accordance with NFPA 13 with respect to hazard classification and shall have automatic sprinkler systems designed for the appropriate classification.

J. Fire Protection Contractor shall furnish and install all alarm and supervisory switches or devices required for the automatic sprinkler system, installed so as to provide an electrically supervised system.

K. The number and location of fire department connections shall be coordinated with the Architect and local Fire Department. The fire department connections shall be piped directly into the building fire protection loop or standpipe system.

L. Each sprinkler riser control valve shall be equipped with a valve supervisory switch and a waterflow switch on piping down stream of the last control valve. Drain piping for each fire protection riser shall be sized and located to accommodate full flow from the main drain under normal system pressure.

M. This project is located within a seismic zone which is subject to earthquakes. Sprinkler systems shall be protected per NFPA 13 to prevent breakage.

## 1.8 QUALITY ASSURANCE

A. The firm, company, corporation, or partnership producing and providing the material and labor of this Section shall have at least 3 years experience performing scope of work described and required by these Contract Documents.

B. Acceptable Fire Protection Contractors meeting the above requirements are as follows:

1. Delta Fire Protection, Salt Lake City, UT
2. Alta Fire Protection, Salt Lake City, UT
3. Fire Engineering Company, Salt Lake City, UT
4. Chaparral Fire Protection, Salt Lake City, UT
5. Firetrol Protection Systems, Salt Lake City, UT
6. Grinnell Fire Protection, Salt Lake City, UT
7. Western Automatic Sprinkler, Salt Lake City, UT
8. Preferred Fire Protection Company, Salt Lake City, UT
9. Aurora Fire Protection, Salt Lake City, UT
10. Shilo Automatic Fire Sprinkler, ID

C. Contractors not listed must submit for acceptance 10 calendar days prior to bid date. Proof of prior experience for Contractors not listed shall be submitted to the Engineer in writing, giving total and complete information of dates, name, address of owner, and location of all projects completed during past 3 years with specific references as to Engineers, and prime contractors involved. List names of companies, phone numbers and project manager's name.

D. Codes and Standards:

1. All work shall conform to the requirements of the following NFPA Standards and Recommended Practices as appropriate for the type of service except as specifically noted in each Section:

a. "Installation of Sprinkler Systems", NFPA 13 - 2007 Edition.
b. "Installation of Standpipe and Hose Systems", NFPA 14 - 2007 Edition.
c. "Installation of Fire Pumps", NFPA 20 - 2007 Edition.

d. "National Electrical Code", NFPA 70 - 2008 Edition.
e. "National Fire Alarm Code", NFPA 72 - 2008 Edition.
f. “Inspection, Maintenance and Testing of Water- Based Suppression Systems”, NFPA 25 - 2008 Edition.

2. All building construction work shall conform to the 2009 International Building Code and 2009 International Fire Code.
3. All work shall conform to the federal, state and local regulations governing this installation.
4. Should any conflicts occur between any code or standard, the most stringent requirement(s) shall apply.
5. The Fire Protection Contractor shall be subject to the interpretation of statutory requirements by the local Fire Department. Acceptance of the completed systems by the local Fire Department is required.

## 1.9 TECHNICAL SUBMITTALS

A. Timely submittals are essential to on-time completion of the project. The Owner will incur no obligation to extend the contract completion date, or to reduce or waive any liquidated damages due, as a result of the Fire Protection Contractor's failure to provide the specified submittals in a timely and acceptable fashion.

B. The information shown on each technical submittal shall be complete with respect to quantities, dimensions, specified performance and design criteria, products, materials, and similar data to enable the Owner, Engineer and Architect to review the information as required. Only complete submittals will be reviewed. Incomplete submittals will be rejected and returned to the Fire Protection Contractor without being reviewed.

C. Each technical submittal shall include a cover letter providing a description of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Fire Protection Contractor shall provide specific notation on each Working Plan, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.

D. No construction or installation will be authorized until the required submittals are received and reviewed by the Owner, Engineer, and Architect. Any construction or installation performed without written authorization from the Owner shall be entirely at the Fire Protection Contractor's own risk.

E. The required Technical Submittals for all systems and equipment installed in accordance with these specifications include:

1. Working Plans, per NFPA 13.
2. Water Supply Information, per NFPA 13.
3. Hydraulic Calculations, per NFPA 13.
4. Operation and Maintenance Manual.
5. Test Protocols.
6. Fire Protection Contractor’s Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.
7. Record Drawings.
8. FM Global.

F. Provide six copies of each required Working Plan, manufacturer’s data sheet, water supply information, hydraulic calculations, and test protocol submittal within 60 days of award of contract.

G. Provide two copies of each required Operation and Maintenance Manual, Material & Test Certificates, and Record Drawing submittal a minimum of 10 working days prior to final acceptance testing.

H. All drawings and diagrams shall be CAD generated using AutoCAD Version 2011, prepared on drawing sheets 30" x 42" in size, and shall contain no extraneous information. Marked up copies of catalog data sheets or manufacturer's "typical" diagrams are not acceptable in lieu of the required drawings or diagrams. All other information required for this submittal shall be submitted in one or more appropriately labeled and indexed 3-ring binders.

I. All drawings and diagrams shall include the Fire Protection Contractor's title block, complete with drawing title, Fire Protection Contractor's name, address, date (including revisions), and preparer's and reviewer's initials.

J. Upon approval of the Working Plans, including completion of any required revisions, the Fire Protection Contractor shall provide one (1) complete, reproducible set and three blueline sets for the Owner, Engineer, and Architect's use in performing field observations during construction.

K. Working Plans for sprinkler systems shall be complete and in full accordance with NFPA 13 Chapter, FM Global on Plans and Calculations.

1. All drawings and calculations shall be reviewed and accepted by the jurisidictional fire department, building department fire marshal, as applicable, and the insurance carrier or insurance reviewing authority prior to submitting to the Engineer. Indication of review and acceptance by all agencies, as appropriate, shall be certified by name of reviewer, agency, and date affixed to the plans or reproducibles submitted to the Engineer. None will be accepted or reviewed until compliance with these terms has been established.

L. Operation and Maintenance Manuals shall be prepared specifically for this project and bound in an indexed 3-ring binder, containing:

1. A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including a testing and maintenance schedule and detailed testing and maintenance instructions for each type of device installed. This description shall include:

   a. A listing of the individual system components that require periodic testing and maintenance.
   b. Step-by-step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed, for each type of device installed. These instructions shall include copies of NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems and NFPA 72 - National Fire Alarm Code.

2. A schedule, which correlates the step-by-step testing and maintenance procedures with the listing of individual components. This schedule shall be completed for the duration of the warranty period or for one complete testing/maintenance cycle whichever is longer.
3. A service directory, including installing company's name and telephone numbers for whoever should be called to obtain both normal warranty service and 24-hour emergency service.

4. Drawings and diagrams, as required.
5. System Calculations.
6. Test reports for system, flow rates, and residual pressures.
7. Certified pump curves (all pumps).
8. Wiring diagrams for all system devices.

M. Upon completion of the installation, submit Record Drawings and Contractor's Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.

N. Record Drawings shall include all variations from the approved Working Plans, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between trades. Variations shall be indicated in sufficient detail to accurately reflect the as-built conditions. Upon completion of the work, before final acceptance, the Fire Protection Contractor shall deliver to the Owner, two (2) additional full size sets of blue lines and one set of AutoCAD drawing data files.

## 1.10 PROJECT CONDITIONS

A. Contractor shall not install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

## 1.11 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

# PART 2 - PRODUCTS

## 2.1 PRODUCT LISTINGS AND APPROVALS

A. All system components for which UL listings categories exist shall be listed by Underwriters Laboratories (UL) or Factory Mutual Research (FM).

1. All components shall be listed in the current edition of the UL Fire Protection Equipment Directory. Components shall be delivered to the project site with factory applied UL stickers.
2. Components for which UL listing approvals are "pending" are not acceptable.

B. All system components shall be used in accordance with the manufacturer's recommendations and their listing.

C. All system components are subject to the approval of the engineer with regard to their fitness for the intended application.

## 2.2 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

## 2.3 INTERIOR AND EXTERIOR ABOVE-GROUND PIPING

A. Pipe and Joints:

1. Black steel and galvanized steel threaded or roll grooved schedule 40 conforming to ASTM A-135 or A-53. Light wall (Schedule 10) conforming to ASTM A-135 or ASTM A-795, where prior approval is obtained from Owner and jurisdiction having authority. All pipe shall conform to NFPA #13, Chapter 3 and Jurisdictional Authorities and Insurance Agency. Where required to meet insurance agency or jurisdictional requirements, all dry pipe system and drain piping shall be galvanized.

B. Fittings:

1. Threaded cast iron, pressure class in accordance with developed system pressures, conforming to ASME B16.4. Threaded malleable iron, pressure class in accordance with developed system pressures, conforming to ASME B16.3.
2. Weld type fittings: Buttweld conforming to ASME B16.9. Flanges conforming to ASME B16.25. Socket weld conforming to ASME B16.11. All welds by certified welder in accordance with Section 230529.
3. Grooved fittings shall conform to ASTM-A47 (malleable), ASTM 536 (ductile), or ASTM-106 GRB (forged steel), ASTM A-53 type E, F, or S GRB (nipples), ASME B-16.5 or B16.1 cast iron and carbon steel flanges.

C. Flexible Connectors:

1. Flexible connector to be stainless steel (304) corrugated tube surrounded with stainless steel (304) wire braid. Provide threaded fittings on each end of the flexible connector.
2. Connector shall have the frictional equivalent of a maximum of 23 ft. of 1” steel pipe (assumes 4’ long tube with four 90° bends).
3. Connectors shall be UL listed, F.M. approved.
4. Provide with support bracing and clamps.

D. Valves:

1. All valves are to be indicating type.
2. All valves U.L. listed, F.M. approved.
3. Refer to Section 230529 for valve specifications.

E. Hangers:

1. All hangers, attachments and components U.L. listed, F.M. approved.
2. All piping hangers shall conform to Jurisdictional Authorities requirements.
3. Powder driven studs shall not be included in normal installation. Permission to use this type anchoring system must be accepted by the Structural Engineer prior to submitting pricing or bids to any contractor or agent relative to this project.

## 2.4 SPRINKLER SYSTEM

A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish, and color provided by the specified make and model.

1. Sprinkler Heads, Alarm, Dry and Deluge Valves, Accelerators, Detector Check Valves, Alarm Horn/Strobe, Air Maintenance Devices, Sprinkler Emergency Cabinets, and Specialties: Reliable, Viking, Notifier, Victaulic, Croker, Potter, Elkhart, Tyco.

B. Sprinkler Heads:

Heads shall be U.L. Listed and of the type required to properly protect the intended space. Heads shall be of ordinary-temperature classification except as required by ceiling temperature, location, or service as allowed or required by code. Provide quick-response heads in all light hazard occupancies.

| LOCATION | ORIENTATION | HEAD FINISH | COVER OR ESCUTCHEON |
|---|---|---|---|
| Office | Recessed | Chrome | White |
| Workout Rooms | Recessed | Chrome | White |
| Elevator Lobbies | Recessed | Chrome | Chrome |
| Entry Lobby | Concealed | Brass | White |
| Storage | Recessed | Brass | Chrome |
| Corridors | Recessed | Brass | White |
| Open Areas (No Ceilings) | Upright/Pendant | Brass | - |
| Equipment Rooms | Upright/Pendant | Brass | Chrome |
| Dock | Upright/Pendant | Brass | - |
| Garage | Upright/Pendant | Brass | - |

C. Escutcheons shall be part of the U.L. Listed sprinkler assembly.

D. Sprinkler Head Cabinets:

1. Steel with red enamel finish for 6, 12, or 24 heads complete with appropriate heads, wrench and mounting.

E. Sprinkler Head Guard:

1. Steel wire cage, chrome finish.

F. Water Flow and Pressure Switches:

1. Paddle Type Flow Switch U.L. Listed, for pipe sizes 1" thru 8", for vertical or horizontal mounting, retard adjustment from 0 to 70 seconds instantly recycling, 10 amp, 120v AC, dual contacts. Notifier Model WFD, or approved equal.

G. Supervisory Switches:

1. Post indicator valve, and gear operator type, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model PIBV2, or approved equal.
2. Gate, OS&Y, and other valves, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model OSY2, or approved equal.

H. Alarms:

1. Exterior Audible and Visual Alarm, U.L. Listed for outdoor use, weatherproof faceplate, horn and strobe. Notifier Model GMS, or approved equal.

I. Dry Pipe Valve: U.L. Listed, control valve. Central Model AF & AG, or approved equal.

1. Provide as required, complete with all trim and drain extensions, for use with pressure switch as indicated.
2. Accelerator: U.L. Listed, complete with trim. Central Model B, or approved equal.
3. Air Maintenance Device: Provide automatic air maintenance device for dry pipe valves. Provide all trim, switches, strainers, valves for complete functional unit.

## 2.5 FIRE DEPARTMENT CONNECTION - INLET (SIAMESE)

A. Cast brass, single clapper, straight or angle style as indicated. Provide siamese connections of sizes, styles and patterns required, caps and chains, and wall plate.

B. Style: Flush.

C. Finish: Polished Brass.

## 2.6 WALL HYDRANT CONNECTION - OUTLET

A. Cast Brass, flush type. Provide wall hydrant outlets of sizes, styles, and pattern required with inlet control valve and valve access.

B. Finish: Polished Brass.

C. Provide Index Plates "Wall Hydrant" - "Wall Hydrant Control Valve" as required.

## 2.7 AIR COMPRESSOR

A. Acceptable Manufacturers: Quincy, Ingersoll-Rand, Grinnell or equal.

B. Provide an automatic belt driven air compressor complete with 30 gallon minimum receiver, auto receiver drain, air cooled after cooler, belt guard, auto start stop - H.O.A., starter, panel, relief valve, pressure reducing valve in conformance with NFPA-13.

C. The air compressor shall be of sufficient horsepower and free air output to provide restoration of the total pipe volume in the system in 20 minutes or less.

D. Air compressor shall be a two stage reciprocating type mounted on a horizontal or vertical receiver and shall not be less than 1 HP. Voltage and phase shall be verified and motors furnished for proper electrical characteristics.

E. Provide a low pressure trouble alarm (NCO Bell) with sensor on inlet side of P.R.V. (between P.R.V. and receiver) set at 10 psig above required system maintenance pressure.

F. Provide air maintenance assembly.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Field Measurements: Verify all dimensions before proceeding with the work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for the accuracy of such measurements and precise fitting and assembly of finished work. Prefabrication of systems is done at this Contractor's own risk.

B. Coordination: Coordinate all work and placement of components with other trades, thorough coordination of design and field installation is expected. Remedial field work may be required to eliminate conflicts and provide an acceptable finished product.

### 3.2 EXCAVATION, BACKFILL, CUTS AND RESTORATION

A. Provide all excavations and backfill in accordance with Section 230529 - Basic Mechanical Materials and Methods.

### 3.3 INSTALLATION

A. General: Provide a complete operable system designed and installed in accordance with applicable local, state, federal and jurisdictional codes, enforcement agencies and insurance rating or underwriting agencies.

B. All systems shall be drainable with proper drainage devices, and drain terminations either to exterior of building or to proper receptacles within building.

C. All systems shall be supported and braced for conformance to proper and applicable standards.

D. Care shall be taken with chrome plated or other polished finish components so that marring does not occur to the finish, and installation provides for a uniform pattern and true installation.

E. Where piping passes thru masonry units or concrete walls or floors or other building construction, sleeves may be used. Where exposed piping passes thru finished work, chrome plated, or other finish acceptable to Architect, split wall plates or escutcheons shall be installed to fit snugly around piping. Where rated walls are penetrated, approved safing shall be provided at each hole to assure effectiveness of construction as a fire stop.

F. All openings for piping should be anticipated and coordinated with General Contractor. Indicate such openings on the shop drawings. Any additional cutting of openings must be coordinated with the General Contractor.

G. Contractor shall complete the automatic fire sprinkler ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges, if any will be paid for by the Owner.

H. Use no face bushings.

I. Furnish and install all wiring for all flow switches, tamper switches, exterior and interior alarm items furnished in this Section. This work may be subcontracted to the Division 26 Contractor if desired by the Section 211000 Contractor but the Section 211000 Contractor shall include the wiring costs in his bid.

J. Provide seismic restraints in accordance with Jurisdictional Agencies.

K. The sprinkler piping shall be concealed from view in all common and public areas with a finished ceiling. Exposed piping shall be cleaned and left ready for painting by others.

L. Provide seismic separation assembly in accordance with NFPA 13 where pipes cross building seismic separation joints or expansion joints.

## 3.4 PERFORMANCE

A. General: Systems shall be engineered and designed for proper densities, ease of maintenance and accessibility. Final main drain flow tests shall be made to prove system design and installation.

## 3.5 CLEANING

A. General: Flush all systems free of all debris and certify system clean and ready for use.

## 3.6 TESTING AND CERTIFICATE OF COMPLETION

A. The entire system shall be hydrostatically tested at not less than 200 psig for not less than 2 hours with 0 psig pressure drop. Tests shall be witnessed by the Architect's or General Contractor’s representative - mandatory.

B. Obtain certificate of compliance and completion for jurisdictional agencies, as applicable and present to Owner - mandatory.

**END OF SECTION**

# DIVISION 22 - PLUMBING


| | |
|---|---|
| Section 22 1410 | Plumbing Piping |
| Section 22 1411 | Disinfecting Water Supply System |
| Section 22 1430 | Plumbing Specialties |
| Section 22 4440 | Plumbing Fixtures |
| Section 22 4450 | Plumbing Specialties |

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# SECTION 22 1410

# PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Water Piping.

B. Soil, Waste and Vent Piping.

C. Storm Water Piping.

D. Testing.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

### 1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230540 - Mechanical Sound and Vibration Control.

C. Section 230548 - Mechanical Seismic Control.

D. Section 230700 - Mechanical Insulation.

E. Section 211010 - Outside Fire Protection System.

F. Section 221411 - Disinfecting Water Supply System.

G. Section 221430 - Plumbing Specialties.

H. Section 224440 – Plumbing Fixtures.

I. Section 224450 – Plumbing Equipment.

## 1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Water Piping, Fittings, and Joints.

## 1.5 SEQUENCING/SCHEDULING

A. Coordinate any system shutdown with Campus Project Manager not less than 7 days prior to proposed shutdown.

# PART 2 - PRODUCTS

## 2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:

   a. Copper tube ASTM B88 Type K shall be soldered to wrought or cast fittings using 95-5 class SnSb (Tin-antimony) solder.
   b. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.
   c. Copper ProPress fittings shall conform to material requirements os ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.
   d. Cast bronze solder joint fittings shall conform to ANSI B16.18.

2. Cast Iron Pipe Fittings and Joints:

   a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
   b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
   c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.

3. Ductile Iron Pipe Fittings and Joints:

   a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
   b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed Joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be made with copper ProPress fittings conforming to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117 or 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3” and larger tube.

   a. Copper only in Central Plant

## 2.2 SOIL DRAIN WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Cast iron pipe centrifugally cast service weight (SV) soil pipe with cast iron drainage fittings conforming to ASTM A 74. Joint materials and systems may be hub and spigot with neoprene gaskets and lubricant conforming to ASA-021 and ASTM C-564 SV pattern. Gaskets shall be equal to U.S. Pipe Company Veri-tite conforming to ASTM-C564 and/or CISPI HSN75 and be certified in writing to the Engineer that the following criteria has been met, thru testing by a recognized independent testing laboratory. Cast iron hubless pipe and fittings conforming to ASTM A 888 or CISPI 301. Hubless couplings shall conform to ASTM C 1277 for standard and ASTM C 1540 for heavy duty or CISPI 310.

   Criteria: Sizes 2" thru 6" shall withstand 15 psig hydrostatic pressure for 10 minutes with <u>unrestrained</u> joints, and no leakage, and using restrained joints must be able to withstand 25 psig air pressure and 40 psig hydrostatic pressure with no leakage. Offset joints shall withstand 1056 pounds of horizontal force without joint separation or detectable leakage.

B. Buried Pipe:

1. Provide SV hub and spigot cast iron pipe and fittings to 5'-0" beyond building excavation line, continue past this point with SV cast iron or XS vitrified clay to termination points with hub and spigot joints. At Contractor's option and where approved by local jurisdiction, No-Hub standard weight cast iron pipe with either M-G couplings or heavy-duty stainless steel shielded couplings may be used in lieu of hub and spigot with Ty-Seal neoprene gaskets. The heavy-duty shielded couplings shall comply with ASTM C1540, with ASTM C564 neoprene gaskets, minimum 0.008" stainless steel shields with transverse corrugations across longitudinal corrugations, standard 304 stainless steel clamps and 305 stainless steel screws. Entire assembly shall be suitable for direct burial, be corrosion resistant, and accommodate pipe deflection.
2. Polyvinylchloride (PVC) sewer pipe and fittings shall conform to DR-35, ASTM D3034, bell and spigot type with reinforced rubber ring gasket integral with bell joint, minimum pipe stiffness at 5% deflection is 46, material to meet ASTM D1784, D2444 and joint tightness in accordance with ASTM D3212.
3. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal

C. Interior Pipe Supported By Hangers and Clamps:

1. Provide S.V. cast iron pipe No Hub System using hubless cast iron soil pipe couplings certified to withstand a minimum of 50 psi internal pressure. Where stack pressures may theoretically exceed 50 psi, use clamp all or heavy-duty couplings with restrained joints horizontal and vertical up to 80 psig. For pressures above 80 psi, use Schedule 40 ASTM A-120 galvanized steel pipe with threaded cast iron drainage fittings. Roll grooved schedule 40 pipe with Victaulic Style 77M galvanized couplers may be used on horizontal and vertical stacks and mains. Use Teflon tape or compound for all threaded joint make-up.
2. Sump pump discharge from the pump to the point the waste stream flows continuously via gravity shall be Schedule 40 galvanized steel pipe with NPT threaded joints and fittings.
3. Copper Waste, Vent and Soil Pipe and Fittings shall be prohibited on this project.

## 2.3 PLASTIC DRAIN, WASTE AND VENT PIPING

A. Plastic drain, waste and vent piping may be installed when in compliance with jurisdictional codes and this specification.

B. Plastic DWV may be either P.V.C. or A.B.S. as required by code and utilizing drainage pattern fittings.

C. P.V.C. (polyvinylchloride) pipe and fittings shall conform to ASTM D2665 with a flame spread rating of 25 or less and shall consist of Schedule 40 DWV pattern.

D. A.B.S. (acrylonitrile - butadiene - styrene) pipe and fittings shall conform to ASTM D2661, CS 270-65, Schedule 40 DWV pattern.

E. All plastic DWV piping shall bear the seal of the National Sanitation Foundation (N.S.F.). None will be accepted without this seal.

## 2.4 SOLVENTS FOR PLASTIC PIPING BELOW GRADE ONLY

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule #1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

B. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

C. Product: IPS Weld-On #2700 or equal

# PART 3 - EXECUTION

## 3.1 WATER TUBE, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 230529.
5. Pull tee (T-drill) fittings are forbidden.

## 3.2 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.

D. Remove construction debris from project site and legally dispose of debris.

## 3.3 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

## 3.4 SOIL, DRAIN, WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Provide bedding, restraints and hangers as appropriate and in accordance with manufacturers recommendations based upon type of pipe, fittings, joints, and bury depth using final finished grading as the basis.
2. Piping shall be run true, plumb, and straight, with all restraints and hangers adjusted to carry their proportional load and locked to prevent pipe "wag" misalignment, movement or shear.

3. Provide anchors for piping risers on every floor using riser clamps, wall brackets, knee brackets, and foot blocks for all vertical piping over 20 feet straight height.
4. Furnish and install all soil, waste and vent piping for the complete sanitary system in accordance with jurisdictional code requirements.
5. All soil and waste piping shall be run at the following minimum slope unless otherwise indicated on drawings.

| Slope of Horizontal Drainage Pipe | |
|---|---|
| Size (In.) | Min. Slope (In./Ft.) |
| 2-1/2 or less | 1/4 |
| 3 to 6 | 1/8 |
| 8 or larger | 1/16 |

6. Bushings in soil waste or vent piping shall be prohibited. Tapped spigots or tees shall be used when changing from cast iron pipe to steel waste or vent piping, and for appropriate cleanout plugs.
7. Vertical Piping: All vertical soil and vent stacks shall be supported with riser clamps at each floor slab. When soil stacks over two stories in height terminate at the bottom on slab fill or native soil, provide stack base elbows set on 24" x 24" x 8" thick minimum poured reinforced concrete pads set directly on undisturbed native soil or fill compacted to same density as undisturbed earth.
8. Horizontal Piping (suspended):

    1. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
    2. Cast iron soil pipe - Where joints occur, suspended cast iron soil pipe shall be supported at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length, may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen (18) inches of the hub or joint. Hubless or compression gasket joints must be supported at least at every other joint except that when the developed length between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection. Supports shall be placed on or immediately adjacent to the coupling. Suspended lines shall be suitably braced to prevent horizontal movement.
    3. Threaded pipe - Threaded pipe (IPS), shall be supported in accordance with Section 230529.
    4. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
    5. For pipe sizes greater than 4 inches, axial restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.

9. The waste connections between fixtures and their respective collection and venting systems shall consist of galvanized steel nipples and cast iron drainage fittings.
10. All interior waste, soil, and vent piping up to 1-1/2" shall consist of galvanized steel with cast iron drainage fittings, all piping 1-1/2" and over shall consist of S.V. cast iron soil pipe and fittings.
11. All pipe and fittings shall have affixed thereon the CISPI grade mark of identification.

12. All vents shall be installed through the roof of at least the minimum size as required by jurisdictional code and shall be cast iron.
13. All vents protruding through the roof shall be not less than 2" size and extended to not less than 12 inches above the finished roof. Vents through built-up roofing shall be flashed with 24" x 24" x 4 lb. sheet lead. The flashing shall extend to top of vent and the edges turned down into a cast iron vent pipe. Single ply rubberized roofing systems shall be flashed around vent with top edge of roofing clamped to vent pipe and sealed with compatible sealant.
14. All vents shall be located in accordance with jurisdictional code and in no case less than two (2) feet from roof edge or parapet, or wall line of an "on the roof structure". Vent terminations shall not occur within twenty-five (25) feet of any outside air intake.
15. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 230548) and jurisdictional authority.

## 3.5 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall <u>not</u> be routed through or above the following locations:

1. Electrical panel rooms
2. Electrical switch gear rooms
3. Electrical transformer rooms
4. Elevator shafts
5. Elevator equipment rooms
6. Data Centers
7. File Server Rooms / MDF / IDF

B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

## 3.6 PLASTIC DRAIN WASTE AND VENT PIPING

A. Plastic piping shall be installed with caution towards expansion and contraction characteristics. The piping shall be free to flex and move without bindings. The pipe shall be securely anchored at the roof to prevent movement at the roof penetrations.

B. Provide solvent weld joints.

C. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

### 3.7 TESTING

A. Schedule of Testing:

| Service | Allowable Test Methods $H_2O$ | CA | $N_2$ | V | Minimum Test Pressure (psig) | Minimum Test Period (minutes) | Allowable Pressure Variance (psig) |
|---|---|---|---|---|---|---|---|
| 1. Potable Water Pipe<br>Valves & Fittings | X | <br>X | | | 125<br>100 | 60<br>60 | -0-<br>+1/2 |
| 2. Sanitary, Storm & Acid Waste and Vent System: | | | | | | | |
| *Stack Height: | | | | | | | |
| 0-23 FT. | X | | | | 10 | 30 | -0- |
| 24-34 FT. | X | | | | 15 | 30 | -0- |
| 35-46 FT. | X | | | | 20 | 20 | -0- |
| 47-57 FT. | X | | | | 25 | 20 | -0- |
| 58-69 FT. | X | | | | 30 | 10 | -0- |
| 70-80 FT. | X | | | | 35 | 10 | -0- |
| 81-92 FT. | X | | | | 40 | 10 | -0- |
| 93-103 FT. | X | | | | 45 | 10 | -0- |
| Over 104 FT. | X | | | | 50 | 10 | -0- |

B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N2 and vacuum testing can be made from connections anywhere in the system tested.

C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.

D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made. The General Contractor/Construction Manager shall witness and SIGN the required test form.

E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.

F. Proper restraining of piping and test plugs shall be accomplished prior to test.

**END OF SECTION**

# SECTION 22 1411

# DISINFECTING WATER SUPPLY SYSTEM

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Disinfection of Domestic Water Supply System.

### 1.2 RELATED WORK

A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 221410 - Plumbing Piping.

### 1.3 DEFINITIONS

A. Disinfectant residual means the quantity of disinfectant in treated water.

B. pH factor means the measure of alkalinity and acidity in water.

C. ppm means parts per million.

### 1.4 CONTRACTOR'S QUALIFICATIONS

A. Water Treatment Contractor: At least three years experience performing work specified herein.

B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

### 1.5 REGULATORY AGENCY REQUIREMENTS

A. Comply with requirements of Local and State Regulations.

### 1.6 SUBMITTALS

A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:

1. Water treatment contractor's evidence of experience.
2. Bacteriological laboratory's evidence of certification.

B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Disinfection Report:

a. Include the following:

Date issued.

Project name and location.

Treatment Contractor's name, address, and phone number.

Type and form of disinfectant used.

Time and date of disinfectant injection start.

Time and date of disinfectant injection completion.

Test locations.

Initial and 24 hour disinfectant residuals in ppm for each outlet tested.

Time and date of flushing start.

Time and date of flushing completion.

Disinfectant residual after flushing in ppm for each outlet tested.

2. Bacteriological Report:

a. Include the following:

Date issued.

Project name and location.

Laboratory's name, certification number, address and phone number.

Time and date of water sample collection.

Name of person collecting samples.

Test locations.

Time and date of laboratory test start.

Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.

Bacteriologist's signature.

## 1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and discoloration.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg.F and 80 deg.F.

D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

## 1.8 PROTECTING WORK OF OTHER TRADES

A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

B. Protect against damage and discoloration caused by work of this Section.

# PART 2 - PRODUCTS

## 2.1 DISINFECTANT

A. Free chlorine; liquid, powder, tablet, or gas.

## 2.2 ALKALI

A. Caustic Soda or Soda Ash.

## 2.3 ACID

A. Hydrochloric type.

# PART 3 - EXECUTION

## 3.1 EXISTING CONDITIONS

A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.

B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.

C. Do not start work until conditions are satisfactory.

## 3.2 PREPARATION OF WATER FOR TREATMENT

A. Verify pH factor of water to be treated.

B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.

C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

## 3.3 SYSTEM TREATMENT

A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.

B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

C. Test for disinfectant residual at each of the following locations:

1. Ends of piping runs.
2. Remote outlets. (Ends of each multiple fixture branch line)
3. Tanks and domestic water heaters.
4. At least 15% of outlets on each floor as directed by Architect/Engineer.

D. Maintain disinfectant in system for 24 hours.

E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

## 3.4 FLUSHING

A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

## 3.5 BACTERIOLOGICAL TEST

A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.

B. Take water samples at each of the following locations:

1. Where water enters system.
2. Ends of piping runs.
3. Remote outlets.
4. Tanks.
5. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.

C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.

D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

## 3.6 PRODUCT CLEANING & REPAIRING

A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.

B. Remove debris from Project Site upon work completion or sooner, if directed.

**END OF SECTION**

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# SECTION 22 1430

# PLUMBING SPECIALTIES

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Drains and drainage products.
B. Downspout nozzle.
C. Storm drain expansion joints.
D. Cleanouts.
E. Safe pans and drain flashings.
F. Sillcocks, yard hydrants, hose bibbs and hose stations.
G. Pressure gauges, thermometers, and test plugs.
H. Shock arrestors.
I. Backflow preventers.
J. Pressure reducing valves.
K. Pressure and temperature relief valves.

### 1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish electrical outlets installed in Washer Wall Box for Division 26 power wiring installation.

### 1.3 RELATED WORK

A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

### 1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Floor Drains (FD)
2. Floor Sinks (FS)
3. Roof Drains (RD)
4. Overflow Drains (OD)
5. Trench Drains (TD)
6. Downspout Nozzles (DSN)
7. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
8. Hose Bibbs (HB) and Hose Stations (HV)
9. Pressure Gauges (PG)
10. Thermometers (T)
11. Shock Arrestors (SA)
12. Backflow Preventer (BP)

13. Pressure Reducing Valve (PRV)

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Backflow Preventer (BP)
2. Pressure Reducing Valve (PRV)

## 1.5 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

A. Where acceptable manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, function, and appearance to the manufacturer listed as the base manufacturer in the specification body or drawing schedules. Deviations of any type will not be acceptable.

B. Where other acceptable manufacturers are not listed, only the base manufacturer will be accepted.

C. All items of like nomenclature shall be supplied by one manufacturer only.

## 2.2 FLOOR DRAINS (FD)

A. Acceptable manufacturers: Wade series 1100, JR Smith series 2005, Josam series 30000, Zurn series Z-415, Watts FD-100 series.

B. Schedule: See Drawings.

## 2.3 FLOOR DRAINS, HEAVY DUTY (FD-C)

A. Acceptable manufacturers: Wade series 1240, JR Smith series 2330, Josam series 31200, Zurn series Z-512, Watts FD-340 series, MIFAB series F-1340C.

B. Schedule: See Drawings.

## 2.4 FLOOR SINKS (FS)

A. Acceptable manufacturers: Wade series 9110/9140, JR Smith series 3100/3150, Josam series 49000/49040, Zurn series Z-1900/Z-1910, Watts FD-860 series, MIFAB series FS-1520/FS-1730.

B. Schedule: See Drawings.

## 2.5 ROOF DRAINS

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200.

B. Schedule: See Drawings.

## 2.6 OVERFLOW DRAIN

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200-R.

B. Schedule: See Drawings.

## 2.7 TRENCH DRAINS, FRAME AND GRATE

A. Acceptable manufacturers: Wade series 2902/2908, JR Smith series 2970/2940/2910, Josam series 76700/76500/76300, Zurn series Z-793/Z-792/Z-784, Watts TD-920 series, MIFAB series T-1200/T-1150.

B. Schedule:

| Plan Code | TD-1 |
|---|---|
| Frame | Steel Angle |
| Grate | Ductile Iron |
| Width | 12” |
| Length | Note 1 |
| Load Class | 2,000-4,999 lb. |
| Vandal Proof Security Screws | No |

Note 1: Provide length as indicated on drawings.

## 2.8 DOWNSPOUT NOZZLES

A. Acceptable manufacturers: Wade series 3940, JR Smith series 1770, Josam series 25010, Zurn series Z-199, Watts RD-940 series, MIFAB series R-1940.

B. Schedule: See Drawings.

## 2.9 EXPANSION JOINTS

A. Acceptable manufacturers: Wade series 3900, JR Smith series 1710, Josam series 26200, Zurn series Z-190, Watts RD-900 series, Metraflex, MIFAB series R-1900, Hyspan.

B. Schedule:

| | |
|---|---|
| Plan Code | EJ |
| Material | Cast Iron |
| Sleeve | Bronze/Brass |
| Gasket | Neoprene or Graphite |
| Size | 2”-10” |

## 2.10 FLOOR CLEANOUTS

A. Acceptable manufacturers: Wade series 6000, JR Smith series 4020/4100/4200, Josam series 56000, Zurn series Z-1400, Watts CO-200-R/200-RX/200-US series, MIFAB series C1100-R/C1100-XR/C1100-UR.

B. Cast iron adjustable body, ABS plug, vandal-proof security screws.

1. Provide flange and flashing clamp for Cleanouts in areas with waterproof membrane and all cleanouts above slab-on-grade.
2. Provide nickel bronze top to match floor finish as indicated in the Architectural finish schedule. Provide heavy duty nickel bronze top for cleanouts in storage rooms, kitchens, and similar areas. Provide heavy duty cast iron or ductile iron top for cleanouts in equipment rooms, traffic areas, parking areas, and similar unfinished areas.

## 2.11 WALL CLEANOUTS

A. Acceptable manufacturers: Wade series 8560 with 8480R, JR Smith series 4530, Josam series 58790, Zurn series 1446, Watts CO-460-RD series, MIFAB series C-1460.

B. Cast iron clean out tee, ABS plug, vandal proof security screws, stainless steel cover with screw.

## 2.12 GRADE CLEANOUTS

A. Acceptable manufacturers: Wade series 8300 MF with 6000 spigot outlet, JR Smith series 4250, Josam series 58850, Zurn series Z-1474 with Z-1449, Watts CO-300 series, MIFAB series C-1300.

B. Heavy duty cast iron clean out housing, heavy duty cast iron or ductile iron cover, cast iron ferrule, ABS plug, vandal proof security screws.

1. Provide piping system identification cast into cover; "SAN" for sanitary waste cleanouts, "STORM" for storm drainage cleanouts.

## 2.13 VENT CAPS

A. Acceptable manufacturers: JR Smith series 1748, Josam series 26700, Zurn series Z-193, Watts RD-680 series, MIFAB series R-1930.

B. Galvanized iron body and dome, vandal proof screws.

## 2.14 SAFE PANS AND DRAIN FLASHINGS

A. Provide one of following systems:

1. 4 lb./sq.ft. sheet lead with 15 lb. asphaltic felt sub pan (underliner).
2. #24 B&S gauge (0.021") minimum sheet copper with l5 lb. asphaltic felt sub pan (underliner).
3. 0.040" non-plasticized chlorinated polyethylene sheet with 30 lb. felt underliner.
4. 3 ply 15 mil polyvinylchloride sheet with 30 lb. felt underliner.

## 2.15 WATER HEATER SAFETY PAN (WHSP)

A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on electric water heaters installed above ceilings, under counters or on wood flooring.

B. Provide Ruud Mfg. Co. "Heater Pan", Canplas or equivalent spun aluminum pan 2” larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

## 2.16 SILLCOCK, EXPOSED, NON-FREEZE

A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71050, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.

B. Schedule: See Drawings.

## 2.17 HOSE BIBBS

A. Acceptable manufacturers: As listed in schedule.

B. Schedule: See Drawings.

## 2.18 MIXING UNIT AND HOSE STATION (HV)

A. Acceptable Manufacturers: T&S Brass, Leonard.

B. Schedule:

| Plan Code | HV-1 |
|---|---|
| Type | Exposed |
| Mix | Cold/Hot Water |
| Temp. Control | Manual |
| Valve Material | Bronze |
| Finish | Rough Brass |
| Thermometer | Yes |
| Shut-Off Valves | Yes |
| Vacuum Breaker | Yes |
| S.S. Hose Rack | Yes |
| Hose | 50 ft. |
| Nozzle | Trigger Operated |

## 2.19 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments.

B. Schedule:

| Plan Code | PG-1 | PG-2 |
|---|---|---|
| Type | 4-1/2" Dial | 4-1/2" Dial |
| Bourbon Tube/Socket | Phosphor Bronze Tube<br>Brass Socket | Stainless Steel Tube<br>316 Stainless Steel Socket |
| Accuracy | ANSI B40.1 Grade 1A<br>1% F.S. over middle half of range | ANSI B40.1 Grade 1A<br>1% F.S. over middle half of range |
| Case | Cast Aluminum | Cast Aluminum |
| Window | Clear Glass | Clear Glass |
| Snubber | Yes | Yes |
| Coil Syphon | For Steam Service | For Steam Service |
| Gauge Cock | Yes | Yes |
| Set Hand | No | No |
| Silicone Filled | No | No |
| Weatherproof | No | No |

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems.

1. Domestic Water 0 to +160 psi
2. Low Pressure Steam -30 in Hg to +60 psi
3. Pump Gauges -30 in Hg to +100 psi

## 2.20 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

| | |
|---|---|
| Plan code: | T-1 |
| Type | Adjustable angle |
| Case | 9" cast aluminum |
| Window | Clear acrylic |
| Tube | Thermistor |
| Stem | Aluminum, insertable |
| Separable Socket | Brass |

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Hot Water Pump Water0 to 150 °F
2. Low Pressure Steam 30 to 300 °F
3. Steam Condensate 30 to 240 °F
4. Domestic cold water 0 to 100 °F
5. Domestic hot water 30 to 240 °F
6. Chilled Water 0 to 150 °F
7. Condenser Water 0 to 150 °F

## 2.21 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment, Weksler, Pete's Plug.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge, gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

| PLAN CODE: | MAKE: | MODEL: | PRESSURE & TEMPERATURE TEST KIT |
|---|---|---|---|
| T&PTP | Trerice | D3741 | Trerice D3750 (0-100 psig) |

## 2.22 SHOCK ARRESTORS FOR WATER (SA)

A. Manufacturer: Precision Plumbing Products Co., Wade Shokstop, J.R. Smith series 5000, Josam series 75000, Zurn Z-1700, Watts SS series.

B. Schedule:

| PLAN CODE | "P.D.I." SIZE | FIXTURE UNITS |
|---|---|---|
| SA-A | A | 1-11 |
| SA-B | B | 12-32 |
| SA-C | C | 33-60 |
| SA-D | D | 61-113 |
| SA-E | E | 114-154 |
| SA-F | F | 155-330 |

## 2.23 REDUCED PRESSURE BACKFLOW PREVENTER

A. Acceptable manufacturers: Conbraco Series 40-200, Watts series 009 and 909, Febco series 825Y, Hersey series FRP-II.

B. Bronze body, independent spring loaded check valves, diaphragm type differential pressure relief valve, shut-off ball valves, strainer, test cocks. Suitable for water temperature range of 33-140 °F.

C. Approved under ASSE 1013 and AWWA C511.

D. Backflow preventer test kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions, in a corrosion resistant carrying case.

## 2.24 PRESSURE REDUCING VALVE (PRV)

A. Acceptable manufacturers: Watts series N223B, Conbraco, Hoffman.

B. 300 psi bronze body, replaceable seat, strainer, adjustable outlet pressure, thermal expansion by-pass. Suitable for water temperature up to 160 °F.

C. Approved under ASSE 1003 and IAPMO.

## 2.25 TEMPERATURE AND PRESSURE RELIEF VALVES (T&P)

A. Acceptable Manufacturers: Kunkle, Watts, Conbraco, McDonnell and Miller.

B. Schedule:

| TYPES | SIZE | MAKE | MODEL | SERVICE | MAX PRESS | ASME MAX TEMP | ASME RATING BTUH MAX. |
|---|---|---|---|---|---|---|---|
| T & P | 3/4" | Kunkle | 137 | Water Pressure Vessel | 125 psig | 250 F | 2,230,000 |
| Press | 3/4" | Kunkle | 84-45 | Air | 125 psig | 300 F | NA |
| Vac | 3/4" | Kunkle | 80-45 | Vacuum | 15" Hg | 300 F | NA |
| T & P | 3/4" | Watts | 40XL8 | Water Heater | 125 psig | 210 F | 777,600 |

## PART 3 - EXECUTION

### 3.1 DRAINS

A. Coordinate drain placement with Contractor for Division 3 - Concrete.

B. Drain, strainer, and grate finishes shall be as specified, cover all finished surfaces during construction to prevent damage.

C. Install drains with "P" pattern traps and vents as required.

D. All drain bodies shall be plugged during construction to prevent foreign objects, dirt, concrete, etc. from entering the drain and drainage piping.

E. Planter drains shall not receive domes until final landscaping is accomplished. Provide closure plugs until landscaping and dome installation is furnished.

F. Drains shall be set flush and level with finished surfaces, with grate pattern parallel or perpendicular to adjacent walls or floor patterns.

G. Flash all drains on roofs, upper floors, and floor over crawl spaces with 24"x24" minimum flashing pans. Shower pans shall be turned up in walls to a minimum of 6" above the shower receptor threshold.

H. Clean and polish all drain bowls, rims, strainers, and grates prior to final inspection.

### 3.2 CLEANOUTS

A. Provide cleanouts in waste, soil, and storm piping at each change in direction greater than 45°, as required by Jurisdictional Code.

B. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, and at each base of waste, soil or storm pipe stack or drop, 100 feet on center for all exterior sanitary and storm piping or as required by jurisdictional code.

C. Provide appropriate access tops for imposed construction.

D. Coordinate interior floor cleanout locations with contractor for Division 3 - Concrete.

E. Cleanouts to be provided with ABS or Delrin plugs. Lead sealed, brass, or cast iron plugs will not be acceptable unless specifically required by jurisdictional code authority.

F. Provide 24"x24" minimum flashing pans and clamp devices for all cleanouts located on upper floors or floors over crawl spaces.

G. Where cleanout arms extend horizontally and/or vertically more than 15 feet from the sewer main which they are serving, provide 2" minimum vent off the end of the arm and connect to the building vent system.

H. Clean and polish all cleanout access covers prior to final inspection.

I. Cleanout access covers shall be flush and level with finished building surfaces.

J. Install cleanout plugs on exposed or accessible piping. Plugs shall be line size up to 3" and over 8", 4" plugs for sizes 4" thru 8".

K. Provide wall cleanouts where piping is concealed in walls or non-accessible chases, use tapped cleanout tee or tapped extension to within 4" of wall face. Do not use no-hub type blind plugs for wall cleanouts. Coordinate cleanout locations with Architect before installation.

L. Provide 12"x12"x8" thick 3000 lb. concrete pads for all grade cleanouts. Concrete shall be in accordance with Division 3 - Concrete. Tops of pads to be 1" above finish grade and cleanout access flush and level and centered in pad surface.

## 3.3 DOWNSPOUT NOZZLES (DSN)

A. Terminate storm and overflow drains into full size nickel bronze downspout nozzles, seal annular space between wall opening and pipe with silicone seal, anchor nozzle wall flange with three 1/4" flat head machine bolts and lead expanders. Set DSN a minimum of 6" and a maximum of 12" above the splash block surface, unless otherwise noted.

B. Install drain pipe to thread adaptors and threaded galvanized schedule 40 nipples or short pipe through exterior wall for threading on the DSN. T.O.E. nipples or short pipe may be used for "NO-HUB" system where galvanized and drain pipe are joined by an approved No Hub coupling adaptor. Anchor pipe to building immediately downstream of adaptor.

C. Coordinate required location of standard splash blocks at all DSN locations for Construction Manager/General Contractor.

## 3.4 STORM DRAIN EXPANSION JOINTS (EJ)

A. Install vertical expansion joints at the roof drain outlet for all drains having straight vertical run directly from the drain of 10 feet or more.

B. Install special horizontal expansion joints at center of runs for horizontal storm piping having one hundred feet of straight run. Anchor ends of run. Provide expansion joints where storm drains cross a building expansion joint. Anchor both sides of building joint or provide adequate swing joints with appropriate anchors.

## 3.5 SANITARY VENT CAPS

A. Install where shown on drawings, vandal resistant vent caps a minimum of 14" above the roof surface.

B. Provide 24"x24"x4 lb. sheet lead flashing up 12" above roof to vent flashing collar.

C. Secure dome and entire assembly tight to pipe.

## 3.6 SAFE PANS AND DRAIN FLASHINGS (no plan code)

A. Provide safe pans for all shower bases, shower rooms, wet rooms and kitchen areas. Pans shall extend wall to wall and turn up at least 6" above finish floor level or receptor rims into wall construction. Pans shall be laid over non-puncturing base such as heavy asphaltic felt, fine sand that bears no silica, or other acceptable material.

B. All drains on upper floors or over crawl spaces shall be flashed with flashing extending a minimum of 12" beyond the drain top dimensions.

C. Seams to be folded and shaped as required:

1. Solder lead seams.
2. Solder sheet copper seams with 50/50 (50% tin, 50% lead) or 45/55 (45% tin, 55% lead) commercial grade solder.
3. Solvent weld PVC and un-plasticized chlorinated polyethylene seams.

## 3.7 WATER HEATER SAFETY PAN (WHSP)

A. Install safety pans for all electric water heaters installed above ceilings, under counters or on wood flooring. Route drain to floor sink/drain with indirect connection.

B. Install safety pans for all gas fired water heaters installed on combustible foundations or where leakage will cause damage. Route drain to floor sink/drain with indirect connection.

C. Provide structural supports, air gapped pan drains, drain extensions and pan drain connections as required.

## 3.8 SILLCOCKS (SC)

A. Provide sillcocks at 100 feet maximum spacing around building perimeter, and at other locations shown on Drawings.

B. Provide all sillcocks with accessible stop and drain valves in heated areas, provide access panels where required.

C. Provide flush or surface mounting, square and plumb to building walls, with supply tube pitched for complete drainout.

D. Anchor all sillcocks with anchor flange provided by manufacturer.

E. Caulk annular space between walls and sillcock and sillcock piping with non-hardening silicone base sealant.

F. Mount sillcocks at 24" above finished grade or surfacing.

G. Where mounting heights other than 24" are shown on the Drawings, the Drawings shall supercede the Specifications.

H. Vacuum breakers to be non-removable.

I. Clean all surfaces including faceplate, box, access door, cam lock and interior of box prior to final inspection.

J. Sillcocks shall not be operated by hand tools, provide 2 keys per sillcock. Units found to be marred due to hand tool operation or other causes, shall be replaced at no increase to the Contract Sum.

K. Clean and polish entire sillcock prior to final inspection.

## 3.9 HOSE BIBBS (HB)

A. Provide hose bibbs in each equipment room, toilet room and kitchen area equipped with floor drainage systems and where shown on drawings, maximum spacing shall accommodate 50 feet of hose to any point within the drainage area measured around obstructions and equipment, in lieu of straight line measurement. Hose bibbs in toilet rooms mounted under standard lavatory, do not install near ADA lavatory where it could impede access.

B. Anchor hose bibb within wall for rigid flush flange mounting.

C. Install bibb true and plumb with wall flange flush to surface, caulk annular space between wall and flange.

D. Mounting height to be 18" above floor in toilet rooms and immediately under furthest lavatory from entry, 60" above floor in equipment rooms or as shown on drawings.

E. Hose bibbs shall not be operated with hand tools, use only tee handle, furnish one tee handle per bibb. Units found marred due to hand tool operation or other causes will be replaced at Contractors expense.

F. Clean and polish hose bibbs prior to final inspection.

## 3.10 MIXING UNIT AND HOSE STATION (HV)

A. Anchor stations with 3/8" mounting bolts and expanders or toggles as appropriate.

B. Install stations true and plumb, complete with hose rack.

C. Mounting height shall be 60" above finished floor unless otherwise specified on drawings.

D. Mount hose and nozzle to station and clean entire unit prior to final inspection.

## 3.11 STATIONARY PRESSURE GAUGES (PG)

A. Provide gauges for steam, water, air and vacuum systems, complete with gauge cocks and snubbers, where required by Drawings.

B. Install in semi or upright position, tilted so as to be readable from floor level.

C. Clean gauge, and glass, and calibrate by test prior to final inspection.

## 3.12 STATIONARY THERMOMETERS (T)

A. Install thermometers where indicated on Drawings in upright position with case tilted to be readable from floor level.

B. Clean case and glass prior to final inspection.

## 3.13 TEMPERATURE AND PRESSURE PLUGS (T&PTP)

A. Provide plugs where periodic temperature and/or pressure indication is required as shown on drawings. Provide 1/4" MPT tapping, cap and seal for plug and extension for insulated pipe as applicable.

## 3.14 SHOCK ARRESTORS FOR WATER (SA)

A. Provide shock arrestors in accordance with Plumbing Drainage Institute (PDI) Standard WH-201 and as shown on drawings.

B. Provide 8"x8" minimum access panels centered on each shock arrestor that is otherwise inaccessible.

C. Shock arrestors shall be mounted as close to the line or quick closing valve as possible. Remote mounting or excessive (over 6") nipple mounting will not be acceptable.

D. Gate valves installed at each shock arrestor will not generally be required. Furnish only where specifically shown on drawings.

E. Each shock absorber piston shall be exercised at least once prior to final installation. (Physically move the piston up into chamber from throat of unit. Use wooden push rod only in the performance of this exercise.)

## 3.15 REDUCED PRESSURE BACKFLOW PREVENTER (BP)

A. Provide reduced pressure type backflow preventers on all connections between the domestic water system and make-up supplies to any non potable system, i.e.: Heating, Boilers, Cooling Towers, Chiller, Evaporative Coolers, and the like.

C. Anchor backflow preventer in place in serviceable and accessible height, coordinate with WSU Facilities personnel for approved locations.

C. Clean and test assembly in place in accordance with State Health Code.

D. Provide funnels and attach to unit per manufacturers instructions, in true, level and plumb position.

E. Provide IPS to solder adaptor to funnel outlet and run type M copper tubing in an unobtrusive manner routed to an approved drain receptor.

F. Hang and anchor drain tubing so as to be rigid and stable.

G. Permanently affix drain outlet at drain receptor so as to be rigid and unmovable.

## 3.1 PRESSURE REDUCING VALVE (PRV)

A. Provide unistrut or similar frame for mounting all components of the pressure reducing valve station.

B. Arrangement shall be as shown on Drawings including by-pass.

C. Provide drain valves both sides of station on headers on low points.

D. Provide unions, strainer, valves, petcocks, gauges, straps and other accessories as detailed on Drawings.

E. Set each pressure reducing valve using full system pressure and flow individually to outlet pressures specified.

F. All gauges shall be installed to be readable from floor level. Provide petcocks on each gauge connection.

## 3.2 TEMPERATURE AND PRESSURE RELIEF VALVES (T & P)

A. Provide temperature and pressure relief valves, with full size drains extended and air gapped to floor drains or approved receptor. Provide relief valves on all water heaters, pressure vessels and closed piping systems per ASME Standard.

**END OF SECTION**

# SECTION 22 4440

# PLUMBING FIXTURES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim.
B. Plumbing Fixture Accessories.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.
B. Section 230500 - Basic Mechanical Requirements.

### 1.3 RELATED SECTIONS

A. Section 221410 - Plumbing Piping.
B. Section 221430 - Plumbing Specialties.
C. Section 224450 – Plumbing Equipment.
D. Section 230529 - Basic Mechanical Materials and Methods.

### 1.4 REFERENCES

A. Comply with the applicable provisions and recommendations of the following:

1. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
2. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
3. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.

### 1.5 SYSTEM DESCRIPTION

A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

### 1.6 QUALITY ASSURANCE

A. Qualification:

1. Provide fixtures trim and specialties in accordance with style, type, quality and function as established by the named manufacturer and model specified for each item.
2. Provide all installations in accordance with jurisdictional code and health authorities standards, restrictions and recommendations.
3. Provide all fixtures and trim using a single manufacturer where possible, deviation will be allowed only where specifications indicate otherwise.

## 1.7 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures.
2. Carriers.
3. P-Traps.
4. Faucets, showerheads, valves, cocks, supplies and stops.
5. Finishes, material and colors.
6. Fixture specialties.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Flush Valves, Faucets and Cocks.
2. Plumbing Fixtures
3. Specialties

## 1.8 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

A. Cast iron and vitreous china: Kohler - Eljer - American Standard – Crane – Zurn – Toto – Mansfield .

B. Stainless steel sink 316, 18 gauge minimum: Elkay - Just - Haws - Kohler.

C. Molded Stone: Fiat - Florestone - Stern Williams - E.L. Mustee.

D. Terrazzo: Fiat - Florestone - Stern Williams - Bradley.

E. Fiberglass and Plastic: Kohler - Snyder - Owens Corning - Bradley - Aquarius - Fiat - E.L. Mustee - Fiberglass Systems - Lasco Hitech - Florestone - Sterling.

F. Dual Flush Water Closet Flush Valves: Sloan – Zurn - Mansfield.

G. Low Flow Urinals: Sloan – Zurn – Toto – Kohler - Mansfield.

H. Electric Water Coolers with bottle filling station: Elkay - Halsey Taylor - Cordley - Haws - Sunroc - Filtrine - Oasis - Acorn.

I. Water Mixing Valves Thermostatic, or Pressure Balanced: Leonard - Symmons - Kohler - Powers - Lawler – Bradley – Watts – Armstrong International - Delta.

J. Flush Valves: Sloan Royal - Delany Flushboy – Zurn – AquaFlush – Toto – AquaVantage – Moen (hands free) - Speakman.

1. All flush valves required “dirt grabber” flush valve filter field installed. See paragraph 2.23 in this section.
2. TPE, chloramines-resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass.
3. ADA-compliant with a non-hold open and no leak handle feature.
4. High back pressure vacuum breaker.
5. Flange for top spud connection.
6. Control stop has internal siphon-guard protection, vandal resistant stop cap.

K. Toilet Seats: Comfort Seats – Olsonite - Beneke - Sperzel- Bemis - Church.

L. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman - McGuire – Zurn - Delta.

M. Chair Carriers: Josam - J.R. Smith - Zurn - Wade – Mifab - Watts.

N. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Cambridge Brass - Moen - Symmons - Speakman - T & S Brass - Zurn.

## 2.2 WATER CLOSETS

A. Wall Hung, Siphon Jet, Valve Operated, Water Saver, 5” rough with open front seat: See Drawings.

## 2.3 LAVATORIES

A. Wall Hung, Vitreous China, Carrier Mounted: See Drawings.

B. Counter Top Mounted Oval: See Drawings.

## 2.4 URINALS

A. Wall Hung, Carrier Mounted, Valve Operated Siphon Jet: See Drawings.

## 2.5 SERVICE SINKS

A. Molded Stone: See Drawings.

## 2.6 FAUCET

A. Lavatory: Moen 8211 or equal, Hand operated valve, no sensors. Two handle faucet, integral stop, built in vandal resistant .5 GPM aerator, 5 year warrantee, ADA compliant. See Drawings.
B. Kitchen/Break room faucet: Hand operated valve, no sensors. Single handle faucet, integral stop, built in vandal resistant .5 GPM aerator, ADA compliant. See Drawings.
C. Service sink/mop sink: Hand operated valve, no sensors. Two handle faucet, integral stop, ¾” hose adapter, 5 year warrantee vacuum breaker, See Drawings.

## 2.7 ELECTRIC WATER COOLERS

A. Wall Hung, Carrier Mounted, Two Level: Elkay bottle filler or equal, See Drawings.

## 2.8 SINKS

A. Enameled Cast Iron Self Rim US. Brass "Valley" Faucet Trim: See Drawings.

B. Stainless Steel, Self Rim: See Drawings.

## 2.9 SHOWERS

A. Individual single handle, Brass body, Concealed Pressure and Thermostatic Balancing Valve and Head. (Stall provided under Architectural Divisions of the Work.) See Drawings. Shower head by Oxigenics or equivalent.

## 2.10 MASTER THERMOSTATIC MIXING VALVES

A. Cabinet mounted and exposed type master mixing valves: adjustable setpoint, thermostatic type, adjustable limit stops, ball valve shut-offs, inlet checkstops, outlet thermometer. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings. Provide high-low manifold type where specified and where required to meet specified range of flow. Low flow individual units serving a single lavatory or small bank of lavatories to be able to control temperature at low flow of .5 GPM.

C. Leonard Type TM, Symmons Series 5, Bradley.

## 2.11 LABORATORY FIXTURES, FAUCETS & COCKS

A. Emergency Shower/Eye Wash Combination:

| Plan Code: | ESW-1 |
|---|---|
| Type: | Wall Mount |
| Make: | Haws |
| Model: | 8300-8309 |
| Supply: | 1-1/4” IPS |
| Valve: | Self-closing (spring return) Ball Valves |
| Control: | Rigid Pull-Rod |
| Finish: | Stainless Steel Bowl<br>Plastic Shower Head |
| Accessories: | 9102: Dust Cover<br>9201H: Lead-Free Thermostatic Mixing Valve |

## 2.12 FIXTURE SUPPLIES & STOPS

A. Schedule:

Sink & Lavatory Supplies: (1/4 turn chrome ball valve, stainless steel braided tube, 1/2” x 3/8”)
(L.K. Stops, 12" Riser, 1/2 x 3/8)

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | SCR 1912 | 1694 LK | 7824-2LK | 2712 KCW | BV8940LK |

DF & Lavatory Supplies: (W.H. Stops, 12" Riser, 1/2" x 3/8")

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | CR 1912 | 1694 | 7824-2 | 2712 SCW | BV8940LK |

Bidet & Sink Supplies: (L.K. Stop, 20" Riser, 1/2" x 1/2")

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | SCR 3920 | 1666 or 1786 | 8135-2/8218-2 | None | BV8940LK |

Bidet & Sink Supplies: (W.H. Stop, 20" Riser, 1/2" x 1/2")

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | CR 3920A | 1695 MOD | 7816-2 | None | BV8940LK |

Water Closet Tank Supplies: (L.K.) Stop. 12" Riser, 1/2 x 3/8)

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | SCR 1912 DL | 1770 LK | 7925-2LK | 3112 KCW | BV8940LK |

Water Closet Tank Supplies: (W.H. Stop, 12" Riser, 1/2 x 3/8)

| | | | | | |
|---|---|---|---|---|---|
| Make: | Brass Craft | Bridgeport | Frost | Dearborn | Watts |
| Model: | CR 1912 DL | 1170 | 7925-2 | 3112 SCW | BV8940LK |

## 2.13 FLUSH VALVE FILTER

A. South Fork Manufacturing “Dirt Grabber” Flush Valve Filter #SFDG1, Telephone 801-953-3001.

## 2.15 EMERGENCY SHOWERS AND EYE WASH EQUIPMENT

A. Comply with ISEA Z358.1.

# PART 3 - EXECUTION

## 3.1 INSPECTION

A. Examination: Examine the contract documents and provide all necessary attachments, accessories, support equipment and materials as necessary to fit allocated spaces.

## 3.2 PREPARATION

A. Field Measurements: Verify all dimensions and installation requirements so that work can be accurately fitted to other construction and in accordance with the intent of the contract documents. Be responsible for accuracy of measurements and adequate space requirements for the precise fitting and assembly of finished work.

## 3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Water Closets:

1. Wall Mounted

   a. Closet carriers are to be rigidly anchored to the floor structure in accordance with manufactures installation instructions.
   b. Wall mounted water closets will be rigidly supported with brass mounting studs on a concealed metal carrier. Transmitting fixture weight loads to the fixture pipe connection or wall framing will not be acceptable.
   c. Water closets and trim shall be set level and plumb.
   d. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
   e. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

2. Water Closet Supplies

   a. Supplies shall be roughed with "L" copper tube nipple through wall cut to exact length and finished with escutcheon, matching fixture trim finish.

3. Water Closet Seats

   a. Secure seats to water closets and adjust self-sustaining check hinge to hold the seat at any raised position. Removable bumpers shall match seat color and be secured.

B. Lavatories:

1. Wall and Counter Mounted

   a. Wall mounted lavatory carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
   b. Carriers are to be furnished with a metal mounting plate and bearing plate.
   c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection <u>is not acceptable</u>.
   d. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
   e. Carriers are to become part of the structure and the lavatories shall not exert any weight or stress on the interior wall.
   f. Lavatories and trim shall be set level and plumb.
   g. Spacing of lavatories shall be in accordance with contract documents and jurisdictional codes.

C. Urinals:

1. Wall Mounted

a. Wall mounted urinal carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
b. Wall mounted urinals are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
d. Carriers are to become part of the structure and the urinals shall not exert any weight or stress on the interior wall.
e. Urinals and trim shall be set level and plumb.
f. Spacing of urinals shall be in accordance with contract documents and jurisdictional codes.
g. Install urinals in accordance with manufacturers installation instructions.

D. Service Sink:

1. Install service sink in accordance with manufacturers installation instructions.
2. Terrazzo service sinks shall be set on a minimum of 1/4" of silica free sand bedding shimmed with copper shims.
3. Wall mounted service sink trap standards are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
4. Install mop hangers over service sinks, on wall adjacent and perpendicular to faucet mounting, so mops drain into sink.
5. Install hose brackets and attach hoses to service sink faucets.
6. Service sinks and trim shall be set level and plumb.

E. Faucets:

1. Mount faucet rigidly to wall.
2. Provide vacuum breaker at hose connection.

F. Electric Water Cooler:

1. Wall Mounted

a. Electric water cooler carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
b. Wall mounted electric water coolers are to be supported by concealed metal carriers. Transmitting fixture weight load to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to studs or wall framing will not be acceptable.
d. Carriers are to become part of the structure and the electric water coolers shall not exert any weight or stress on the interior wall.

G. Sinks:

1. Each sink compartment shall be separately trapped and wasted to wall, continuous waste is not acceptable.

2. Undercounter dishwasher waste shall be provided with air gap fitting through sink backledge and waste to a dishwasher directional tee upstream of sink trap. Do not connect dishwasher to disposer tap inlet.
3. Furnish separate wheel handle angle or straight stops on dishwasher supplies.

H. Showers:

1. Stall Showers

a. Waste outlets for shower compartment receptors shall be a minimum of 3 inches in diameter with a removable strainer.
b. All shower stalls except those having metal enameled receptors, shall have a lead or copper shower pan or the equivalent thereof as determined in Section 221430.
c. The shower drain grate area shall be not less then 1-1/2 times the free area of the waste pipe.

I. Master Pressure and Thermostatic Mixing Valves:

1. Install master thermostatic mixing valves in accordance with manufacturers installation instructions. Limit maximum temperature to 110 deg. F. by setting temperature limit stop for handle.

J. Fixture Supplies and Stops:

1. Provide fixture supplies and stops on every individual fixture or appliance.
2. Stops shall be compression by compression types with flexible straight copper tube risers, loose key or wheel handles stops. Provide one key per fixture for all loose key (L.K.) stops.
3. All components, stops, risers, inlet pipe and escutcheon shall be chrome plated brass, polished stainless steel, or special finish as specified for fixture trim.
4. Supplies and stops shall be anchored rigidly behind walls, eliminating push or pull movement.

K. Escutcheon Plates:

1. Provide cast brass chrome plated single piece escutcheons for all penetrations of piping thru walls, floors, or ceilings in finished and unfinished areas.

L. Faucets and Flushometers:

1. Faucets and flushometers shall be anchored rigidly behind walls, eliminating any push or pull movement.

M. Caulking:

1. All wall and floor mounted fixtures shall be caulked with a non-hardening white or fixture color match for colored fixtures adhesive elastomeric sealant compound providing a watertight seal at the joint with the walls or floor.

## 3.4 ELECTRICAL COORDINATION

A. Coordination of electrical service for all electric water coolers, garbage disposal units and whirlpool tubs will be the responsibility of the Division 23 contractor in accordance with Section 230529.

## 3.5 FIXTURE CONNECTIONS

A. Provide supply and waste connections for fixtures in accordance with the following table of minimum sizes or larger as required by jurisdictional codes, or drawings.

| Fixture Description: | Hot Water: | Cold Water: | Waste: | Vent: |
|---|---|---|---|---|
| Water Closet (WC) | | | | |
| Flush Valve: | NA | 1” | 4” | 2” |
| Water Closet (WC) | | | | |
| Tank Operated: | NA | ½” | 4” | 2” |
| Lavatory (L): | ½” | ½” | 1-1/4” | 1-1/4” |
| Urinal (U): | | | | |
| Flush Valve: | NA | ¾” | 2” | 1-1/2” |
| Service Sinks (SS): | ½” | ½” | 3” | 1-1/2” |
| Sink (S): | ½” | ½” | 1-1/2” | 1-1/2” |
| Drinking Fountain (DF): | NA | ½” | 1-1/4” | 1-1/4” |
| Electric Water Cooler (EWC): | NA | ½” | 1-1/4” | 1-1/4” |
| Shower (SH): | ½” | ½” | 3” | 1-1/2” |
| Emergency Shower/Eye Wash | 1-1/4” | 1-1/4” | 2” | 1-1/2” |

## 3.6 FAUCET OPERATING ROTATION

A. Standard 2 handle faucets shall rotate as follows:

1. Hot Water clockwise to "on", counter clockwise to "off".
2. Cold Water counter clockwise to "on", clockwise to "off".

B. Wrist blade handle faucets:

1. Initial setting at "off" (rest) position shall have handles parallel to the fixture apron or counter front.
2. Hot Water; Counter clockwise to full on (1/4 turn), clockwise to "off".
3. Cold Water; clockwise to full on (1/4 turn), counter clockwise to "off".

## 3.7 ADJUSTMENT AND CLEANING

A. Adjustment: Adjust all flush valves, faucets, metering devices, shower heads, gas, air and vacuum cocks, and bubblers for proper flow and action after flushing operations are accomplished.

B. Cleaning: Clean all fixtures, trim, accessories and attachments including strainers, traps, aerators, and valves.

## 3.8 FLUSH VALVE FILTER "DIRT GRABBER"

A. Plumbing contractor shall install a SFDG1 "Dirt Grabber" flush valve filter according to manufacturer's installation instructions in each urinal or toilet diaphragm-type flush valve manufactured by Sloan, Zurn or Taiko prior to turning water into the flush valve, but after water lines have been flushed according to local code or engineering specifications. The filtering media shall contain openings no larger than 0.0092" and consist of a minimum of 2-3/4 square inches of filtering material.

All other flush valves must contain a filtering device similar to the "Dirt Grabber" to protect the seating area from foreign debris which may enter the flush valve with the water. (The filtering media shall contain openings no larger than 0.0092" and consist of a minimum of 2-3/4 square inches of filtering material and shall not restrict water flow or result in a reduced volume of water per flush.

Note: The SFDG1 "Dirt Grabber" Flush Valve Filter is manufactured by:

South Fork Manufacturing
798 No. Sage Dr.
Morgan, Utah 84050
Phone: 801-953-3001
Fax: 801-829-4146

**END OF SECTION**

# SECTION 22 4450

# PLUMBING EQUIPMENT

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Water Heater

B. Domestic Water Heater Circulating Pumps

### 1.2 RELATED WORK

A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

Section 221410 - Plumbing Piping.
Section 221430 - Plumbing Specialties.
Section 224440 - Plumbing Fixtures
Section 230500 - Basic Mechanical Requirements.
Section 230529 - Basic Mechanical Materials and Methods.
Section 230540 - Mechanical Sound and Vibration Control.
Section 230548 - Mechanical Seismic Control.
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Controls
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps

### 1.3 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Instantaneous Water Heater
2. Pumps

### 1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with ASHRAE 93-77 (ANSI B198.1) Methods of Testing TO DETERMINE THE THERMAL PERFORMANCE OF SOLAR COLLECTORS.

## 1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Pumps
2. Water Heaters, Accessories and Controls

B. Test Reports: Submit certified test data for the Collector assembly by an independent lab showing compliance with ASHRAE 93-77 and in accordance with General Conditions of the Contract.

## 1.6 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500.

# PART 2 - PRODUCTS

## 2.1 PRODUCT ACCEPTANCE

A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.

B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.

C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

## 2.2 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Bell and Gossett
3. Grundfos
4. Armstrong
5. Patterson

B. Provide in-line type circulating pumps, all bronze construction, bronze face bracket, cast bronze one piece enclosed type impeller hydraulically and dynamically balanced, alloy steel shaft with cupro-nickel shaft sleeve, carbon/ceramic mechanical shaft seal, non metalic noiseless coupler, resilient mounted dry proof motor with sleeve bearings and over load protection, pump bearing and seal assembly shall be replaceable cartridge design, one cartridge and seal to fit all pumps supplied, provide two extra cartridges and seals, oil level dip sticks (one for each pump), and oil drain plug, 125 psig @ 240 deg.F rating.

C. Provide one aquastat pump operating switch for remote mounting as shown on drawings. (One switch per pump).

D. Schedule: See Drawings.

## 2.3 ELECTRIC POWERED STORAGE TYPE WATER HEATERS

A. Acceptable Manufacturers: A.O. Smith, Hatco, Lochinvar, P.V.I. Industries, Ruud, State Industries, Bradford White.

B. Description and Schedule:

1. Provide energy efficient blanket or foam insulation R=16 minimum, glass-lined tank rated for 150 psi working pressure, 300 psi test ASME Code Construction UL listed and in conformance with ASHRAE 90.1 Energy Conservation Standards.

2. Provide ASME certified pressure and temperature relief valve, built-in heat trap to prevent thermal siphoning, low watt density, "INCOLOY" immersion heating elements. Density shall not exceed 80 watts per square inch at 240 volts.

3. Provide magnesium anode rod, cold water dip tube, enameled steel jacket, pre-wired, accessible control and wiring block, one thermostat for each element, step control thermostats to be immersion mounted and adjustable from 100 to 190 deg.F low water level and low water pressure cut off with indicating trouble lights for each contactor function temperature and pressure gauges hand hole cleaner shunt trip disconnect manual limiting switches.

4. Schedule: See Drawings

5. Provide five year full non-prorated full replacement warranty.

## 2.4 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

A. Acceptable Manufacturers: International Technology Sales Corp. (trade name ITS), Chronomite Industries, Bradford White, Rinnai, Noritz, Takagi, Bosch, Stiebel Eltron.

B. Warranty: 1 year full non-prorated for entire unit, including the element.

C. Standard: UL 499 for electric, tankless water heating appliances.

D. Construction: Copper piping or tubing complying with NSF 61, with ASME B 1.20.1 pipe thread connections, rated to 150 PSIG, flow control fitting, electric resistance heating element, high-temperature limit cutoff, and housed in an aluminum or steel jacket with enamel or plastic finish.

E. Schedule: See Drawings

F. Provide power cord; plug, mounting brackets, stops, and connection as required. Be responsible to coordinate with appropriate power supply receptacle provided by Division 26 Contractor.

## 2.5 WATER HEATER MIXING VALVE (TWV)

A. Acceptable Manufacturer:

1. MCC Powers Process Controls, Bradley.

B. Hydraulically Operated Valve:

1. Three way water mixing valve to proportionally mix hot and cold water, die cast aluminum housing, synthetic diaphragm, cadmium plated spring, Teflon-Asbestos packing ring, ball bearing spring and adjustment. monel stem, stem lubricator, bronze trim and guided valve plugs.

2. Provide reverse acting controller with copper bulb well, for fail safe operation.

3. Schedule: See Drawings

C. Self Contained Mixing Valve (Non Fail Safe):

1. Three way water mixing valve to proportionally mix hot and cold water, liquid filled capillary, Monel valve stem, Teflon-asbestos packing, 8 foot capillary tube, and with 4" dial thermometer.

2. Schedule: See Drawings

3. Fail Safe Trim for Self Contained Valves:

a. 1" solenoid valves (normally closed): ASCO #8210 B-54 with Teflon seal, 120v-60 hertz.
b. Temperature Switch: ASCO SA11A/QJ10A with QP-03 copper well with 1/2" NPT connection, 120v-60 hertz adjustable dead band (8 deg.F at mid range) adjustable operating range of 100 deg.F to 220 deg.F, 5 amps resistance of 120 VAC.
c. Standard amber jeweled light 1/2" dia minimum, 1 amp max with mounting plate and junction box for wall or bracket mounting.
d. Intermediate relays: ASCO #197-660 with #255-220 socket base with back box for wall or bracket mounting.

# PART 3 - EXECUTION

## 3.1 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Coordinate wall mounted "on-off" toggle switch for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Set pump level, plumb and square where indicated on contract documents on vertical pipe leg extended to and supported by floor, provide floor plate and capped leg at floor.

C. Provide drain valve on pump support leg at 18" above floor.

D. Anchor vertical pump leg pipe so as to prevent movement and vibration.

## 3.2 FIELD QUALITY CONTROL

A. Repair or replace solar collector units which leak or fail to perform as indicated, or are damaged or have broken their seals.

## 3.5 ELECTRIC POWERED STORAGE TYPE WATER HEATERS

A. Set level and plumb, adjust burners to proper flame, set temperature, and verify, to 135 deg. F minimum setting.

B. Coordinate electrical service and control with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

C. Provide an expansion tank on the hot water side of all water heaters.

D. Set level and plumb, adjust elements to proper sequence and temperature setting.

E. Provide ASME temperature and pressure relief valve with full size discharge piped and air gapped to nearest floor drain or other acceptable receptacle.

F. Provide hose and drain valve, mixing valve, blending chamber shut off valves and dielectric connections as required or appropriate.

## 3.6 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

A. Attach firmly to structure, provide union connections and install per manufacturers, U.L., and jurisdictional authorities requirements and recommendations.

B. Units shall be level, plumb and square.

C. Provide unit isolation valves and unions.

D. Provide factory trained technician for start up of all units.

E. Coordinate electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

## 3.7 WATER HEATER MIXING VALVE

A. General:

1. Be responsible to provide or have provided hydraulic supply electrical power and control wiring and required accessories.
2. Set valve with control bonnet in upright and plumb position.
3. Provide at least 36" clearance between top of blending chamber and any heat holding surface such as ductwork and ceilings.
4. Valve speed adjustment shall be made by authorized factory trained technician. Arrange for these services when building is occupied and in operation.
5. Caution: Valves must be piped in accordance with the contract documents and supplied with appropriate control functions as intended by the designed operation mode, deviations from these intentions may harm the valve and control

components, and if the valve is damaged, it shall be replaced, not repaired by the Division 22 Contractor.

6. Blending chamber connections and piping must be exactly as indicated on the contract documents.
7. Provide "Type L" drawn copper tube blending chamber with 95-5 tin antimony soldered connections. 3/4" NPT at one end (for bulb well), full line size solder connection at bottom 6" from chamber end (at bulb end) for inlet and full line size solder connection at other end for outlet. Chamber size to be as scheduled in Part 2.
8. Hydraulic and pneumatic valves must be piped as follows, when used with reverse acting "Accritem" controller to effect fail safe operation: IMPORTANT = Hot Water from heater to be piped into "U" port, cold water and hot water recirculating by-pass to be piped into "B" port, tempered water to blending chamber piped from "C" port. DO NOT PIPE THE VALVE FOR STANDARD NON FAIL SAFE CONFIGURATION.

9. Self contained valves must be piped with hot water from heater in "B" port, cold water and hot water recirculating by-pass in "U" port, tempered water to blending chamber piped from "C" port.

    a. Provide safety purge system for self contained non fail safe valve consisting of a 1" cold water by-pass to blending chamber outlet with check valve and 1" solenoid valve (normally closed), a purge line off blending chamber outlet with a 1" solenoid valve (normally closed) a temperature switch with thermal bulb inserted into the blending chamber at the outlet end, an intermediate relay, and amber jeweled trouble light.
    b. Self contained valve setting for temperature switch: Set to "make" at temperature 10 deg.F above valve setting and reset at 10 deg.F below valve setting. Valve setting equals system design temperature.

**END OF SECTION**

## DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING


| | |
|---|---|
| Section 23 0080 | Selective Mechanical Demolition |
| Section 23 0500 | Basic Mechanical Requirements |
| Section 23 0529 | Basic Mechanical Materials and Methods |
| Section 23 0540 | Mechanical Sound and Vibration Control |
| Section 23 0548 | Mechanical Seismic Control |
| Section 23 0593 | Testing, Adjusting, and Balancing |
| Section 23 0700 | Mechanical Insulation |
| Section 23 0800 | HVAC Systems Commissioning |
| Section 23 0810 | Variable Frequency Drives |
| Section 23 0900 | Electronic Controls |
| Section 23 2113 | HVAC Piping and Specialties |
| Section 23 2123 | HVAC Pumps |
| Section 23 2500 | HVAC Water Treatment |
| Section 23 3300 | Ductwork and Accessories |
| Section 23 3400 | Air Handling Fans |
| Section 23 3600 | Air Terminal Units |
| Section 23 3713 | Air Inlets and Outlets |
| Section 23 4100 | Air Cleaning |
| Section 23 5700 | Heat Transfer |
| Section 23 6400 | Refrigeration |
| Section 23 7410 | Air Handling Units with Coils |

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# SECTION 23 0080

# SELECTIVE MECHANICAL DEMOLITION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or mechanical systems.
2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Section 015000 - Temporary Facilities and Controls
2. Section 017419 - Construction Waste Management and Disposal
3. Section 024119 - Selective Structure Demolition
4. Section 211000 - Fire Protection
5. Section 230500 - Basic Mechanical Requirements
6. Section 230529 - Basic Mechanical Materials and Methods
7. Section 233300 - Ductwork and Accessories

### 1.3 DEFINITIONS

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

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

C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed or removed and reinstalled.

### 1.4 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of removal work, with starting and ending dates for each activity.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.

5. Means of protection for items to remain and items in path of waste removal from building.

## 1.5 PROJECT CONDITIONS

A. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

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

C. Utility Service: Maintain existing utilities in service and protect them against damage during selective demolition operations.

# PART 2 - PRODUCTS (Not Used)

# PART 3 - EXECUTION

## 3.1 EXAMINATION

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

B. 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.

## 3.2 UTILITY SERVICES AND MECHANICAL SYSTEMS

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

## 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.

1. Comply with requirements for access and protection specified in Section 015000 - Temporary Facilities and Controls.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people.

1. Comply with requirements of Section 017419 - Temporary Facilities and Controls.

## 3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Remove existing mechanical systems only to the extent required and as indicated. Use methods required to complete the Work within limitations of governing regulations.

B. Removed and Reinstalled Items:

1. Clean items to functional condition adequate for intended reuse.
2. Protect items from damage during transport and storage.
3. 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.

C. Existing Items to Remain: Protect construction to remain against damage and soiling during selective demolition.

## 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC SYSTEMS

A. Piping includes: Pipe, fittings, valves, accessories, hangers and insulation.

1. Where existing piping is to be removed:

a. Piping shall be drained, disconnected, removed and capped at an active main.
b. Piping not to remain in use shall be removed completely.

2. Where existing piping is to be relocated:

a. Piping shall be drained, disconnected and removed as shown.
b. Hangers may remain if they are to be reused for reinstallation.
c. Piping shall be stored for reinstallation.

B. Ductwork includes: Ductwork, fittings, dampers, registers, grilles, diffusers, accessories, hangers and insulation:

1. Where existing ductwork is to be removed:

a. Ductwork shall be disconnected, removed and capped at an active main.
b. Ductwork not to remain in use shall be removed completely.

2. Where existing ductwork is to be relocated:

a. Ductwork shall be disconnected and removed as shown.
b. Hangers may remain if they are to be reused for reinstallation.

c. Ductwork shall be stored for reinstallation.

C. Where piping or ductwork to be removed is concealed in construction it may be abandoned in place if capped at both ends and approved by the Owner and the Architect.

## 3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, 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.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage.
3. Comply with requirements specified in Section – 017419 Construction Waste Management and Disposal.

B. Burning: Do not burn demolished materials.

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

## 3.7 CUTTING AND PATCHING

A. All necessary cutting and patching shall be done by the General Contractor.

B. Removal and replacement of suspended ceilings necessary for selective demolition of mechanical systems shall be done under this section.

**END OF SECTION**

# SECTION 23 0500

# BASIC MECHANICAL REQUIREMENTS

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 23 and other Divisions and Sections of the Specification where referenced.

B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 23.

C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

D. Inspection: Inspect work preceding or interfacing with work of Division 23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.

E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 230000 work.

F. Commissioning is required on this project. Reference sections 230900, 019113.

### 1.2 GENERAL PROVISIONS

A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230900 and other sections referenced in 019113.

### 1.3 RELATED WORK

A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

B. Division 1 Commissioning, coordinate as required.

### 1.4 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

A. Provide all building services extensions and connections to off-site and on-site utilities.

B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 23 Contractor.

C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Site Utilities Contractor.

D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 23 Contractor.

G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.

H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.

1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

## 1.5 REFERENCES

A. General:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. The date of the standard is that in effect at the date of the Contract Documents, except when a specific date is specified.
3. When required by individual Specification sections, obtain copy of standard. Maintain copy at job site during work until substantial completion.
4. Coordinate and reference with Division 016500.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

| | |
|---|---|
| ADC | Air Diffusion Council<br>1000 E. Woodfield Rd.<br>Schaumburg, IL 60173<br>www.flexibleduct.org |

| | |
|---|---|
| AGA | American Gas Association<br>400 No. Capitol St. N.W.<br>Washington, DC 20001<br>www.aga.org |
| AMCA | Air Movement and Control Association<br>30 West University Drive<br>Arlington Heights, IL 60004<br>www.amca.org |
| ANSI | American National Standards Institute<br>1819 L Street N.W.<br>Washington, DC 20036<br>www.ansi.org |
| ARI | Air Conditioning and Refrigeration Institute<br>4301 No. Fairfax Drive.<br>Arlington, VA 22203<br>www.ari.org |
| ASHRAE | American Society of Heating, Refrigeration and Air Conditioning Engineers<br>1791 Tullie Circle, N.E.<br>Atlanta, GA 30329<br>www.ashrae.org |
| ASME | American Society of Mechanical Engineers<br>Three Park Avenue<br>New York, NY 10016<br>www.asme.org |
| ASPE | American Society of Plumbing Engineers<br>8614 W. Catalpa Ave.<br>Chicago, IL 60656<br>www.aspe.org |
| ASSE | American Society of Sanitary Engineering<br>901 Canterbury<br>Westlake, OH 44145<br>www.asse-plumbing.org |
| ASTM | American Society for Testing and Materials<br>100 Barr Harbor Dr.<br>West Conshohoeken, PA 19428<br>www.astm.org |
| AWS | American Welding Society<br>550 N.W. LeJeune Rd.<br>Miami, FL 33126<br>www.aws.org |
| AWWA | American Water Works Association<br>6666 West Quincy Avenue<br>Denver, CO 80235<br>www.awwa.org |

| | |
|---|---|
| CDA | Copper Development Association<br>260 Madison Avenue<br>New York, NY 10016<br>www.copper.org |
| CISPI | Cast Iron Soil Pipe Institute<br>5959 Shallow Ford Rd., Suite 419<br>Chattanooga, TN 37421<br>www.cispi.org |
| CS | Commercial Standard of NBS<br>(U.S. Dept. of Commerce, National Institute of Standards and Technology)<br>Government Printing Office<br>Washington, D.C. 20402 |
| CTI | Cooling Technology Institute<br>530 Wells Fargo Drive<br>Houston, TX 77090<br>www.cti.org |
| ICC | International Code Council<br>5203 Leesburg Pike, Suite 600<br>Falls Church, VA 22041<br>www.intlcode.org |
| IAPMO | International Association of Plumbing and Mechanical Officials<br>20001 E. Walnut Drive South<br>Walnut, CA 91789<br>www.iapmo.org |
| NEBB | National Environmental Balancing Bureau<br>8575 Grovemont Circle<br>Gaithersburg, MD 20877<br>www.nebb.org |
| NEC | National Electric Code (of NFPA) |
| NEMA | National Electric Manufacturer's Association<br>1300 N. 17th Street<br>Rosslyn, VA 22209<br>www.nema.org |
| NFPA | National Fire Protection Association<br>One Batterymarch Park<br>P.O. Box 9101<br>Quincey, MA 02269<br>www.nfpa.org |
| NSF | NSF International<br>789 No. Dixboro Rd.<br>Ann Arbor, MI 48113<br>www.nsf.gov |

| | |
|---|---|
| OSHA | Occupational Safety Health Administration<br>(U.S. Dept. of Labor)<br>Government Printing Office<br>Washington, D.C. 20402<br>www.osha.gov |
| PDI | Plumbing and Drainage Institute<br>45 Brystal Drive<br>South Easton, MA 02375<br>www.pdionline.org |
| SMACNA | Sheet Metal and Air Conditioning<br>Contractor's National Association<br>4201 Lafayette Center Drive<br>Chantilly, VA 20151<br>www.smacna.org |
| UL | Underwriters Laboratories, Inc.<br>333 Pfingston Rd.<br>Northbrook, IL 60062<br>www.ul.com |

## 1.6 DEFINITIONS

A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words of phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

F. General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

## 1.7 QUALITY ASSURANCE

A. Quality Control:

1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.

B. Proof of Performance:

1. Division 23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.

C. All system components, controllers, host computers, portable terminals, and similar equipment, all hardware and software (including third party products) furnished by this contractor shall conform to the following:

1. General Integrity: No value for current date (minimum range from 1980 to 2036) will cause any interruption in operation.
2. Date Integrity: Date-based functions shall behave consistently for dates prior to, during, and after Year 2000 (minimum range from 1980 to 2036).
3. Explicit/Implicit Century: The century in any date shall be specified either explicitly or by unambiguous algorithms or inferencing functions.

## 1.8 REGULATORY REQUIREMENTS

A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
International Fuel Gas Code
State Department of Health Requirements
State Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards
Code and Manual for the Design and Installation of Mechanical Warm Air Heating Systems – Nation Warm Air Heat and Air Conditioning Association (NWAH and ACA) Manual #9, 4th Edition.
ASME Boiler Construction Code for Low Pressure Heating Boilers.
ASME Boiler and Pressure Vessel Code.
Unfired Pressure Vessels – ASME Boiler and Pressure Vessels Codes, including Sec. VIII
Code of Minimum Requirements for Comfort Air Conditioning (ASHRAE).
Building Materials and Structures (BMS).
American Standard Plumbing Code ASA A40.
Utah Plumbing Code.
Uniform Building Code of the Pacific Coast Building Officials Conference.
Utah Code for Energy Conservation in New Building Construction.
Ogden City Codes and Regulations as applicable.
State of Utah Boiler and Pressure Vessel Compliance Manual.
Standards of Tubular Exchanger Manufacturers Association – TEMA Standards for Class "C" Heat Exchangers.
Standards for the Installation for Air Conditioning and Ventilating Systems other than Residence Type – National Board of Underwriters (NBFU) and National Fire Protection Association (NFPA) Pamphlet No. 90A.
NBFU Sprinkler Equipment Standards.
American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.
American Welding Society Sandards.
DFCM Design Manual.
Weber State University Design and Construction Standards

C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

## 1.9 SUBMITTALS

A. Submit items to Commissioning Agent for review. Contractors are required to submit Mechanical Cost Breakdown to Engineer when submitting shop drawings. Shop drawings will not be accepted without a complete Mechanical Cost Breakdown. See last page of this Section for requested breakdown. If your standard compilation of bids is different than our requested breakdown, please send it in your format. We need the data to keep our cost estimating files up to date. Just fill-in blanks with a pencil, typing is not required.

B. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.

C. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be both electronic (Adobe Acrobat .pdf format) and hard copies enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder.

D. Test Reports: Submit certified test reports as required by various Sections of Division 23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.

E. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.

F. Submittals will be reviewed and marked as follows:

1. Approved: Submittals are accepted as submitted.
2. Make Corrections Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to Engineer.
3. Revise as Noted: Correct the submittals per notes by Engineer and resubmit to Engineer for approval.
4. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to Engineer.
5. Submittal Not Requested: Submittal not required per specification. Submittal returned with no review.

G. Note that the submittal review process does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.

H. Site Condition and Coordination:

1. Before any ductwork is fabricated or equipment installed and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms and main access walkways coordinated with all trades with submitted equipment and verify all other areas to assure himself that they can be run and installed as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work and maintain access walkways are clear for maintenance.

## 1.10 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.

B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.

C. NOTE: When alternate or substitute materials and equipment are used Division 23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 23 Contractor.

## 1.11 PROJECT RECORD DOCUMENTS

A. General: Comply with Division 1.

B. Job Site Documents: Maintain at the job site, one record copy of the following:

1. Drawings, including mechanical, plumbing and fire sprinkler.
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.

2. Dimensioned location of internal utilities and appurtenances concealed in construction.
3. Field changes of dimension and detail.
4. Changes by change order or field order.
5. Details not on original contract drawings.
6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.

E. Record the following information on Specifications:

1. Changes by change order or field order.
2. Other matters not originally specified.

F. Contractor redlines due to Architect/Engineer by “Certificate of Occupancy” issued to Owner.

G. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

H. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

## 1.12 OPERATING AND MAINTENANCE DATA

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of final reviewed submittals shall be included for all equipment items.

B. Five sets of bound manuals will be required for this project. These are to be submitted for approval to the Project Manager. Five electronic versions of the manuals are also required, as described in Paragraph I below.

C. Division 23 Contractor shall submit all information in electronic (Adobe Acrobat) format (CD) in addition to five (5) typed and bound copies of the maintenance manual, 8-1/2” x 11” in size, to the Mechanical Consulting Engineer for approval before substantial completion. These approved copies will be returned to the Contractor and shall then be transmitted to the Owner.

D. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.

E. Enclose the material in rigid 3-ring or metal post binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram or metal post binders or prior approved equal with block lettering. Simple binders with slide-in cover sheets are not acceptable. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"
2. Project Name (and volume number if more than one volume)
3. Project number
4. Building name, number, and street address
5. * Architect's name

6. * Engineer's name
7. * General Contractor's name
8. * Mechanical Contractor's name

* Items "5" through "8" need not be printed on the backbone.

F. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

G. The manual shall be both electronic (Adobe Acrobat .pdf format) and hard copy enclosed in a stiff-back, three-ring binder and shall include the following:

1. Alphabetical list of all system components( index) including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown. Note that these instructions are for entire systems. Simply providing manufacturer’s shutdown procedures for individual components is unacceptable.
3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and complete systems and necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
5. Manufacturer's data and instruction sheets for each piece of equipment, marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed on the project. These data sheet shall be accompanied by reviewed submittals that had no exceptions taken to them. Provide original printed material in each book, faxes are NOT acceptable. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols. Locate like items together for ease of Owner search for items.

    a. Installation instructions.
    b. Drawings and specifications (final shop drawings).
    c. Parts lists.
    d. Complete parts lists, and a source of supply for each piece of equipment, marked with model, size, and plan symbol.
    e. A copy of the reviewed submittals for each piece of equipment, with any/all corrections identified during the submittal process made to the final submittal documents.
    f. Performance curves and capacity data, marked with model number, size, and plan code.
    g. Complete “as-builts” wiring and temperature control diagrams. (Shop drawings are not acceptable).
    h. Lubrication and other preventative maintenance data.
    i. Equipment warranties.
    j. The final balance report.

6. Design Intent Document furnished by Engineer.
7. Include a Table of Contents and tabbed index dividers.

H. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
2. Tag all manual operating valves per requirements in Section 230529.
3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating valve ID number, location, service and function of each tagged item, and normal valve position. Insert a copy of tag list in each "Maintenance Manual". Also provide one copy of the list in a plastic closure as manufactured by Seton Name Plant Company, New Haven, Conn; or approved equal. The plastic closure shall include two holes punched at the top, with a brass or nickel grommet in each hole, and an 8” long length of nickel plated bead chain run through the holes, allowing the list to be hung from a wall peg.
4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.

I. Operating and Maintenance Data documents must be provided in digital format as follows:

1. Provide O&Ms in an intuitive format on a CD-ROM or DVD. Electronic manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete electronic operation and maintenance manual. Qualifications shall be submitted for approval. One source of procurement used on past projects is Emanuals by Scanitall in Sandy, UT (tel. 801-619-2082). This is the responsibility of the Division 21/22/23 contractor.
2. A single CD or DVD to be authored with the latest edition of Adobe Acrobat, and be in a “non-protected” network accessible format.
3. All information on the CD-ROM or DVD shall be printable on 8.5”x11” or 11”x17”plain paper.
4. Capture images using OCR technology such that the user can key word search for information.
5. Provide a hypertext alphabetical index of all equipment and building products. All hypertext shall be blue in color.
6. Provide 3 copies of the O&M CD-ROM or DVD.

## 1.13 OPERATING AND MAINTENANCE MANUALS

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of both electronic (Adobe Acrobat .pdf format) and hard copy descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Also, provide a CD-ROM that includes all O & M information included in hard copy. Copies of approved submittals shall be included for all equipment items.

B. Four sets will be required for each project. These are to be submitted for approval to the Project Manager.

C. All data and instruction sheets shall be marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed. These data sheets shall either be reviewed and approved submittals or shall be accompanied by such.

D. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

F. Additionally, the following information is to be included:

1. A complete parts list(s) and source of supply for each piece of equipment, marked with model, size, and plan symbol.
2. A copy of the approved submittals for each piece of equipment.
3. The balance report.
4. Performance curves and capacity data, marked with model & size and plan symbol.
5. Wiring diagrams and control sequences marked with model, size and plan symbol in hard copy and AutoCAD format.
6. Control sequences and point schedules from Control Contractor.

G. Enclose the material in rigid 3-ring binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram binders or prior approved equal with block lettering. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches.

H. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"
2. Project Name (and volume number if more than one volume)
3. Project number
4. University name, Building name, number, and street address
5. * Architect's name
6. * Engineer's name
7. * General Contractor's name
8. * Mechanical Contractor's name

* Items "5" through "8" need not be printed on the backbone.

I. Include a Table of Contents and tabbed index dividers.

## 1.14 DEMOSTRATION & TRAINING

A. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. This individual will be knowledgeable of all systems and manufacturers maintenance and operation recommendations. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified. These meetings to be video-taped.
Two (2) WSU Technicians to attend factory training (80 Hrs) off site.
Two (2) WSU Technicians to attend training on site (8 Hrs), First training at project completion and Second training at 6 8 months after.

1. Submit training certificate and copy of video to Owner's Representatives at end of training and have certificate signed to indicate adequate training has been received.

## 1.15 DELIVERY, STORAGE AND HANDLING

A General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

## 1.16 PROJECT CONDITIONS

A Accessibility and Coordination:

1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall hold coordination meetings with all trades and Contractors of other Divisions of the Work whose work is in the same space and shall provide coordination drawings showing mechanical, sheet metal, electrical, data, plumbing, fire sprinkler, and indicate pinch points and verify all items will fit before any fabrication is begun or equipment is ordered. Keep one (1) set of these drawings on site at all times. Provide a set of these drawings to the Construction Manager, General Contractor, Commissioning Agent, Architect, and Engineers for review. Such spaces and clearances shall, however, be kept to the minimum size required.

2. Division 23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
3. Division 23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Division 23 Contractor to coordinate all utility shutdowns with Campus Project Manager at least 7 days prior to the proposed shutdown.

E. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms with submitted equipment and verify all other areas to assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

F. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

G. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

H. If Contractor during the course of work observes or suspects the existence of asbestos in the structure or building, Contractor shall promptly notify Owner and Architect/Engineer. Owner shall consult with Architect/Engineer regarding removal or encapsulation of the asbestos material and Contractor shall not perform any work pertinent to the asbestos material prior to receipt of special instructions from Owner through the Architect/Engineer.

## 1.17 COORDINATION

A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

B. Coordination with Electrical Work: Section 230529.

C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

D. Cutting and Patching: Section 230529.

E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.

F. Each Division 23 subcontractor shall coordinate with other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).

G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.

H. Order of Precedence: The precedence of mechanical construction documents are as follows:

1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
2. Should there be a conflict within the Specifications or within Drawings of the same scale, or between the Specifications and the Drawings, the more stringent or higher quality requirements shall apply.
3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

I. Schedule all shutdowns of utilities 2 weeks prior to shutdown with Weber State University Campus Design Office.

## 1.18 START-UP PROCEDURES

A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.

B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.

C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.

D. Factory personnel shall be notified as appropriate to start systems requiring their services.

E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

## 1.19 SCHEDULE OF TESTING

A. Provide testing in accordance with the General Conditions of the Contract.

B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.

D. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.

E. Make all specified tests on piping, ductwork and related systems as specified in this specification.

F. Make sure operational and performance tests are made on seasonal equipment.

G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

## 1.20 CLEANING AND FINISHING

A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.

B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

## 1.21 WARRANTIES

A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.

C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

## 1.22 PROJECT CLOSEOUT

A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

## 1.23 CERTIFICATES AND KEYS

A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.

B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

## 1.24 UNIT PRICES

A. Refer to Section 012200 – Unit Prices where scope and description of unit prices are given.

**END OF SECTION**

# SECTION 23 0529

# BASIC MECHANICAL MATERIALS AND METHODS

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Work furnished but not installed by this Contractor:

1. Access doors in accordance with paragraph 2.3 in this Section 230529.

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

### 1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an ASME Certified welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work. Welder Qualifications:

1. Each welder shall have passed a qualification test within the past 6 months.
2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

### 1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.
2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.

4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSIB31.1) Code for Pressure Piping.
6. State of Utah, Division of Facilities Construction and Management Design Criteria.
7. Weber State University Design and Construction Standards for Architects, Engineers and Contractors, revised October 2009.
8. Use all applicable inspection, testing, and turnover forms by DFCM Design Criteria dated June 11, 2009, Mechanical Appendix 1, Attached in Part 3 of this section.

## 1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Legend and color of piping and equipment identification.
2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
3. Domestic Hot Water Heat Maintenance System.
4. Proposed access door sizes and locations.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. Motors.
2. Starters.

C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

# PART 2 - PRODUCTS

## 2.1 MOTORS

A. General: Furnish motors necessary to operate mechanical equipment.

B. Motor Characteristics: Comply with the following requirements:

1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.
2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F insulated.

4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 95% under rated load conditions. The 95% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 95% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 95% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be premium efficiency type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.

    a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
    b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 23 for other enclosure requirements.
    c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
    d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
    e. Motor Connections: Provide conduit connection boxes.
    f. Motors shall not exceed 80dbA rating when running their full speed and power range.

## 2.2 STARTERS

A. Note that some starters are furnished and installed under Division 26. Review electrical plans before bidding.

B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 23.** Approved manufacturers shall be those listed in Division 26 or this specification.

C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 260000 will be accepted. All starters shall comply with Division 260000 requirements.

D. Manual Control:

1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.

E. Automatic Control:

1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:

a. Maximum number of auxiliary contacts available: three or more.
b. "Hand-Off-Automatic" switches in starter cover.
c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.
d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.

1) Control circuit conductors to be protected in accord with the National Electrical Code.

e. Trip-free thermal overload relays, each phase.
f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
g. Undervoltage release or protection.
h. Phase failure/phase reversal protection on all legs.

F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

G. Note that some starters are furnished and installed under Division 26.

## 2.3 ACCESS DOORS

A. Furnish access steel access doors, 24”x24” minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.

B. Standard Doors:

1. Frames: 16 ga. steel.
2. Panels: 14 ga. steel.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
6. Style of doors shall be appropriate for architectural finish at door location. Furnish masonry anchors where required.

C. Fire Rated Doors:

1. Frames: 16 ga. steel.
2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Continuous type, steel with stainless steel pin.
5. Closer: Automatic closing mechanism.
6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
7. Style of doors shall be appropriate for architectural finish at door location.
8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

D. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect.

E. Doors shall be installed by the General Contractor.

F. Access doors are to be lockable in public places.

## 2.4 VALVES

A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2” and smaller. Use gate valves on pipes larger than 2”. Use globe valves on manual bypass lines.

4. Provide like type valves of one manufacturer only unless specified otherwise.
5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.

   a. Bronze Valves: Powell, Milwaukee, Crane, Hammond, Nibco.
   b. Iron Body Valves: Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
   c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Pratt, Kennedy, Mission, Milwaukee, Hammond.
   d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco, FNW.
   e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco, IFC, FNW.
   f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
   g. Non-Lubricated Eccentric Plug Valves: DeZurik.
   h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Prier, Nibco or United Brass.
   i. Gas Cock: Peter Healy or Crane.
   j. Check Valves: Nibco, IFC, DFT.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/B62. No brass materials will be accepted.

   a. Check, Gate, and globe with union bonnet and rising stem.
   b. Sizes 1/8 through 2 inches.
   c. Schedule:

| Plan Code: | G.V. | GL.V. | C.V. | L.C.V. |
|---|---|---|---|---|
| Valve Type: | Gate | Globe | Swing | Lift |
| Make: | Nibco | Nibco | Nibco | Crane |
| Straight Threaded: | T-134 | T-235Y | T-433Y | 365.5 |
| Straight Soldered: | S-134 | S-235Y | S-433Y | -- |
| Angle Threaded: | -- | T-335Y | -- | -- |
| Angle Soldered: | -- | -- | -- | -- |

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.

   a. Gate, globe and check.
   b. Sizes 1/8 through 2 inches.
   c. Schedule:

| Plan Code | G.V. | GL.V. | C.V. | L.C.V. |
|---|---|---|---|---|
| Valve Type: | Gate | Globe | Swing | Lift |
| Make: | Nibco | Nibco | Nibco | Crane |
| Straight Threaded: | T-134 | T-235Y | T-433Y | 365.5 |
| Straight Soldered: | S-134 | S-235Y | S-433Y | -- |
| Angle Threaded: | -- | T-335Y | -- | -- |
| Angle Soldered: | -- | -- | -- | -- |

3. Standard Iron Body Valves - 125 SWP/200 CWP:

   a. Gate, globe and check.
   b. Sizes 2-1/2 through 12 inches.
   c. Schedule:

| Plan Code: | G.V. | OS&Y | GL.V. | C.V. | W.C.V. | N.S.C.V. |
|---|---|---|---|---|---|---|
| Valve Type: | Gate | Gate | Globe | Swing | Weighted | Non Slam |
| Make: | Nibco | Nibco | Nibco | Nibco | Nibco | Crane |
| Straight Threaded: | T-619 | T-617-0 | T-718B | T-918Y | T-918YBLW | -- |
| Straight Flanged: | F-619 | F-617-0 | F-718B | F-918Y | F-918YBLW | 23 |
| Angle Threaded: | ---- | ---- | T-818B | | ---- | ---- |
| Angle Threaded: | ---- | ---- | F-818B | ---- | ---- | ---- |

4. Standard Iron Body Valves - 150 SWP/300 CWP:

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

| Plan Code: | G.V. | OS&Y | GL.V. | C.V. | N.S.C.V. |
|---|---|---|---|---|---|
| Valve Type: | Gate | Gate | Globe | Swing | Non Slam |
| Make: | Nibco | Nibco | Nibco | Nibco | Crane (Chapman) |
| Straight Threaded: | T-669 | T-667-0 | -- | -- | -- |
| Straight Flanged: | F-669 | F-667-0 | F-768B | F-968B | 223 |
| Angle Threaded: | -- | -- | -- | -- | -- |
| Angle Flanged: | -- | -- | F-868B | -- | |

5. Standard Iron Body Valves - 250 SWP/500 CWP:

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.

c. Schedule:

| Plan Code: | G.V. | OS&Y | GL.V. | C.V. | N.S.C.V. |
|---|---|---|---|---|---|
| Valve Type: | Gate | Gate | Globe | Swing | Non Slam |
| Make: | Nibco | Nibco | Nibco | Nibco | Crane |
| Straight Threaded: | T-669 | T-667-0 | -- | -- | -- |
| Straight Flanged: | F-669 | F-667-0 | F-768B | F-968B | 223 |
| Angle Threaded: | -- | -- | -- | -- | -- |
| Angle Flanged: | -- | -- | F-868B | -- | -- |

6. UL and FM Approved Valves:

   a. Gate, check and butterfly.
   b. Sizes all.
   c. Schedule:

| Plan Code: | OS&Y | C.V. | W.V.C. | BF.V | D.V. |
|---|---|---|---|---|---|
| Valve Type: | Gate | Swing | Wafer | BTFY | Drain |
| Make: | Nibco | Nibco | Nibco | Demco | Nibco |
| Straight Threaded: | T-104-0 | T-413W | -- | -- | T-211Y |
| Straight Flanged: | F-607-0 | F-908-W | -- | -- | -- |
| Wafer: | -- | -- | W-900-W | NE-H | -- |

7. UL and FM Approved Valves - 175 Pound Water.

   a. Post indicator with indicator post.
   b. Sizes 4 through 12 inches.
   c. Schedule:

| Plan Code: | P.I.V. | P.I.V.B.F. |
|---|---|---|
| Valve Type: | Gate | BTFY |
| Make: | Nibco | Demco |
| Straight Flanged: | F-609 | NE-H (Wafer) |
| Mechanical Joint: | M-609 | -- |
| Indicator Post Vertical: | NIP-1 | Stem extension and gear operator with post indicator U.L. Listed only. |
| Indicator Post through Wall: | NIP-2 | -- |

8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

   a. Gate valves with service boxes.
   b. Sizes (see schedule).

c. Schedule:

| | | |
|---|---|---|
| Plan Code: | GV & SB | GV & SB |
| Size/Inches: | 3/4 thru 2 | 2 thru 16 |
| Valve Type: | Oriseal | Gate |
| Make: | Mueller | Mueller |
| Model: | H-15201 | A-2380-22 or 2380-18 |
| Service Box: | H-10396-86 | H-10357 |
| Base: | H-10396-7-8-9 or H-10400 | No. 6 Oval |
| Key: | Stationary rod attached. | A-24610 Furnish one each box. |

9. Ball Valve:

a. Blowout proof stem.
b. Full port type with appropriate seals and seat, as specified.
c. Bronze bodies per ASTM B61/B62 or ASTM B-584. No brass material will be accepted.
d. Stainless steel bodies per ASTM A-351, Grade CF3M.
e. Schedule:

| | | | | |
|---|---|---|---|---|
| Plan Code: | B.V. | B.V. | H.V. | S.B.V. |
| Service: | Balancing | In line control and isolation | Refrigeration | Steam and Steam Condensate |
| Pressure: | 150 SWP/300 CWP | 150 SWP/300 CWP | 500 CWP | 150 SWP |
| Sizes/Inches: | 1/4 thru 2-1/2 | 1/4 thru 3" | 3/8" thru 2 1/8" | ½” thru 2” |
| Make: | Nibco | Nibco | Nibco | Nibco |
| Straight Threaded: | T-580-70-66 | T-585-70-66 | -- | T-595-Y-S6R-66 |
| Straight Solder End: | S580-70 | S585-70 | S595-Y-66 | -- |
| Actuator: | Lever with memory stop | Lever | Lever | Lever |
| Port: | Standard | Full | Full | full |

* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

10. Butterfly Valves:

a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

| | | | |
|---|---|---|---|
| Plan Code: | BFV | | |
| Style: | Semi-lug wafer body | | |
| Pressure Rating ANSI Class: | 150 minimum | | |
| Body: | Cast Iron | | |
| Disc: | Aluminum Bronze | | |
| Stem: | 316 Stainless | 18-8 Stainless | 17-4 PH Stainless |
| Seat: | EPDM (-40 deg.F to 250 deg.F) | | |
| Actuator: | 2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents or where valve is located more than 8" above floor. | | |
| Make: | Keystone | | |
| Size: | 2"-12" | 14"-20" | 24-36 |
| Model: | 228 | 122 | AR1 |

b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

| | | |
|---|---|---|
| Plan Code: | BFV | |
| Style: | Lug | |
| Pressure Rating ANSI Class: | 300 minimum | |
| Body: | Carbon steel ASTM A-216 | |
| Disc: | 316 stainless steel ASTM A-216 | |
| Stem: | Stainless steel ASTM A564 Type 630 (17-4PH) | |
| Seat: | Virgin TFE | |
| Actuator: | 3" and 4": Rachet handle with lock. 6 and over: Worm gear with lock. | |
| Make: | Flowseal (Mark Controls Corp.) | |
| Size: | 3" and 4" | 6" and over |
| Model: | XX-3L-121TTH-L | XX-3L-121TTH-2 |

11. Stop Check Valve:

a. Schedule:

| | |
|---|---|
| Plan Code: | S.C.V. |
| Pressure: | 250 SWP/500 CWP |
| Size/Inches: | 2-1/2 thru 10" |
| Make: | Crane |
| Straight Flanged: | 28E |
| Angle Flanged: | 30E |

12. Eccentric Plug Valve:

a. Schedule:

| | | |
|---|---|---|
| Plan Code: | E.P.V. | E.P.V. |
| Pressure: | 175 lb. CWP | 175 lb. CWP |
| Size/Inches: | 1/2 thru 3 | 4 thru 8 |
| Make: | DeZurik | DeZurik |
| Model: | 400 | 100 |
| Actuator: | 483-487 | 159 w/Memory Stop |
| Ends: | Threaded | Flanged |

13. Specialty Valves:

a. Petcock, stop and drain, drain, needle.
b. Schedule:

| | | | | |
|---|---|---|---|---|
| Plan Code: | PTK | S&D.V. | D.V. | N.V. |
| Type: | Petcock | Gate | Ball | Needle |
| Pressure: | 250 LB. | 125 LB. | 125 LB. | 200 LB. |
| Size/Inches: | 1/8 | 1/2 and ¾ | 3/4 | 1/8 thru 3/4 |
| Make: | Powell | Nibco | Apollo | Jenkins |
| Model: | 922 | 76 or 726 | 78-104 | 743G |
| Ends: | Threaded | Threaded or Soldered | Threaded and Hose End Adaptor | Threaded |

## 2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.

2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:

    a. Safety factor of 5 (actual load vs. ultimate load).
    b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
    c. Factory Mutual Engineering Division (FM) as applicable.
    d. Manufacturers Standardization Society (MSS).

5. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96.
6. Provide detail of proposed hanging and attachment methods for review before any installation begins.

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "Galvilite by ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "Galvilite by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275, www.zrcworldwide.com" or equal.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot-proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
4. Hangers for insulated piping shall be provided on all piping of this size with insulation shields or insulation saddles* as applicable and appropriate and in accordance with the following schedule:

| Nominal Pipe or Tubing Size | Shield Length | Shield Gauge Thickness | Material |
|---|---|---|---|
| ½" thru 3" | 12" | 18 | Galvanized |
| 4" | 12" | 16 | Galvanized |
| 5" | 15" | 16 | Galvanized |
| 6" | 18" | 16 | Galvanized |
| 8" | 24" | -- | B-line (B3160-3165) |
| over 8" | 36" | -- | B-line (B3160-3165) |

* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".

6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.
7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
9. Hanger spacing and minimum rod sizes shall be based on the applicable Mechanical and Plumbing Codes for the type of piping installed.
10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum). At a minimum, install pipe clamps on every other trapeze hanger, and where required to comply with seismic restraint design.
13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factory of 5.
15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
16. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
17. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.
18. For plenum applications use pipe supports that meet ASTM E-84 25/50 standards.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.

   a. B-Line
   b. Fee & Mason
   c. Grinnell
   d. Hubbard Enterprises/HOLDRITE

e. P.H.D.
f. Michigan
g. Tolco

## 2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.
3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

| Insulation or Pipe Diameter | Length of Color Field | Size of Letters |
|---|---|---|
| 3/4" to 1-1/4" | 8" | 1/2" |
| 1-1/2" to 2" | 8" | 3/4" |
| 2-1/2" to 6" | 12" | 1-1/4" |
| 8" to 10" | 24" | 2-1/2" |
| over 10" | 32" | 3-1/2" |
| Ductwork and Equipment | NA | 2-1/2" |

## 2.7 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer: Epco Sales Inc., Victaulic.

B. Schedule: (complete unions)

| Model: | FX | GX |
|---|---|---|
| Sizes: | ½" thru 2" | 2" thru 12" |
| Maximum Pressure: | 250 psi | 175 psi |
| Maximum Temp.: | 210 deg. F | 210 deg. F |
| Epconite Gasket: | #2 | #2 |
| Ends: | FPT x Solder | FPT x Solder |
| Type: | Union | Flanged Union |

C. Schedule: (companion flanges)

| Model: | X | W | H |
|---|---|---|---|
| Sizes: | 1-1/2" - 10" | 1-1/2" - 12" | 1-1/2" - 12" |
| Maximum Pressure: | 175 psi | 175 psi | 175 psi |
| Maximum Temp.: | 210 deg. F | 210 deg. F | 210 deg. F |
| Epconite Isolators: | #2 | #2 | #2 |
| End Style: | Solder (Brass) | Weld neck | Iron Pipe Thread |
| Type: | Companion | Companion | Companion |
| Face Gasket: | Same as Isolators | | |

D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

## 2.8 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

## 2.9 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
2. Joints: ASTM B32, solder, Grade 95TA.

# PART 3 - EXECUTION

## 3.1 GENERAL INSTALLATION

A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends. Install all equipment, valves, etc. to be accessible and maintainable without any extreme or unusual effort such as removing duct, air handlers, structure, etc.

B. Protection:

1. Close ends of pipe and ductwork during construction and cover equipment to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.

C. Quiet Operation and Vibration:

1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 23.

## 3.2 WELDING

A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.

B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.

C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

## 3.3 ELECTRIC WIRING

A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.

B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

| Item | Furnished By* | Set By* | Power Wiring* | Control Wiring* |
|---|---|---|---|---|
| Equipment Motors | MC | MC | EC | MC |
| Motor Starters & Overload Heaters | MC – Except when shown on MCC | EC | EC | MC |
| Variable Frequency Drives (VFD's) | MC | EC | EC | MC |
| Fused & Unfused Disconnect Switches, Thermal Overload & Heaters | EC | EC | EC | -- |
| Manual Switches & Speed Control Switches carrying full load currents. | MC | EC | EC | EC |
| Fire/Smoke and Smoke Dampers | MC | MC | EC – Requires emergency power circuit if air system served is on emergency power. | EC |
| Control Relays & Transformer (See Note 2) | MC | MC | EC | MC |
| Thermostats (Line Voltage) | MC | EC | EC | EC |
| Temperature Control Panels | MC | MC | EC | MC |
| Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown. | EC | EC | EC | EC |
| DDC Interface to Fire Alarm System | MC | MC | EC | MC |
| Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers. | MC | MC | EC | MC |
| Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats | MC | MC | MC | MC |
| Pushbutton Stations & Pilot Lights (manually operated switches not carrying load currents). | MC | MC | N/A | MC |

| Item | Furnished By* | Set By* | Power Wiring* | Control Wiring* |
|---|---|---|---|---|
| Pushbutton Stations & Pilot Lights carrying fully load current. | MC | EC | EC | N/A |
| Exhaust fans when switched with room lights. | MC | MC | EC | EC |
| Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system. | FPC | FPC | FPC | FPC |
| Water Softener Timeclocks, Timers, Lock-out Devices, Wheatstone Bridges and Meters | MC | MC | EC | MC |
| Temporary Heating Connections | MC | MC | EC | MC |
| HVAC Water Treatment Interlocks and Glycol Pumps | MC | MC | EC | MC |

* MC = Mechanical Contractor under Division 23 of the work.
* FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.
* FPC = Fire Protection Contractor.
* EC = Electrical Contractor under Division 26 of the work.

D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

## 3.4 SLEEVES, PLATES AND CLOSURES

A. Division 23 Contractor shall provide and locate pipe sleeves, and inserts 1” larger, clear dimension, than the outside of the pipe, required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located. Sleeves for insulated piping shall be large enough to allow the covering to pass through the sleeve. Caulk or seal as required to make sure water does not penetrate through sleeve.

B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.

C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure. Link seal shall not be used on fire lines.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:

1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
2. Seal annular space around pipes watertight at floor penetrations.
3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
4. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.

C. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries or Willoughby Industries.

D. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.

E. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.

F. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract <and paragraph 3.7 of this Section>.

G. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

## 3.5 FOUNDATIONS, PADS AND CURBS

A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.

B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 23 Contractor.

C. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

## 3.6 EXCAVATING AND BACKFILLING

A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.

C. Do not place backfill over pipe lines until lines are properly tested.

D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

## 3.7 CUTTING AND PATCHING

A. Openings in New Construction:

1. Provisions for New Openings: The Division 23 Contractor shall verify all openings required in the new construction in connection with the work under Division 23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.

B. Cutting in New Construction:

1. Failure on the part of the Division 23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.

C. Patching in New Construction:

1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.
2. The Division 23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 23 Contractor to coordinate all requirements.

E. Patching in Existing Building:

1. The Construction Manager shall provide for patching all existing walls and floors to match existing.

## 3.8 PIPE HANGERS/SUPPORTS

A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.

B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.

C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.

D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.

E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.

F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

## 3.9 INSTALLATION OF VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each leg of domestic hot water return piping of two branches or more, all heating/cooling water returns and/or supplies to equipment as shown on Contract Documents.
5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitors closets, storage rooms, etc.
6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.

    a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
    b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
    c. Backflow prevention: Check.
    d. Water hammer prevention: Silent or pilot operated non slam check.
    e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

D. Access to Valves:

1. Install all valves, balancing valves and meters in clear open accessible position so valve information and position can easily be read and maintained. Valve position to be reviewed by Campus Project Manager and/or maintenance personnel. If valve is installed without review and valve is determined to be non-accessible by Campus Project Manager, valve to be removed and relocated to new location by this contractor at no additional charge.

## 3.10 PAINTING

A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.

B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.

C. Exposed gas piping to be cleaned, primed and two coats of paint (grey).

D. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 23 Contractor.

## 3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.

B. Methods for identification shall be as follows:

1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.

3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.

Size of Legend and Letters for Stencils:

| Insulation or Pipe Diameter | Length of Color Field | Size of Letters |
|---|---|---|
| ¾" to 1-1/4" | 8" | 1/2" |
| 1-1/2" to 2" | 8" | 3/4" |
| 2-1/2" to 6" | 12" | 1-1/4" |
| 8" to 10" | 24" | 2-1/2" |
| over 10" | 32" | 3-1/2" |
| Ductwork and Equipment | NA | 2-1/2" |

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work.)

| Legend | Background Color | Direction Arrow | Pressure |
|---|---|---|---|
| Condensate | Orange | Arrow | PSI |
| Feed Water | Green | | |
| Chilled Water | Light Green | Arrow | |
| Steam | Yellow | Arrow | PSI |
| Steam Condensate | Yellow | Arrow | |
| Blow Down | Yellow | | |
| Domestic Cold Water | Light Green | | |
| Domestic Hot Water | Yellow | | |
| Sprinkler-Fire | Red | | |
| Refrigerant Liquid | Red | Arrow | |
| Refrigerant Suction | Red | Arrow | |
| Refrigerant Hot Gas | Red | Arrow | |

C. Identification of Piping: Identify all piping accessible for maintenance in crawl spaces, above ceilings, and access spaces as well as exposed to view utilizing or stenciled markings according to the following procedures:

1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
2. If flow can be in both directions, use a double-headed arrow indication.
3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
8. Insulated piping equipped with electric heat trace shall additionally be labeled “Electric Traced” with label of same size and color as the pipe legend.

D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).

E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.

F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.

G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.

H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.

I. Air Conditioning Equipment: Air conditioning equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.

J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.

K. Lift Out Ceilings: Provide engraved nameplates or black lettering on transparent adhesive labels on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.

L. Expansion tanks shall be labeled to indicate system served and precharge pressure.

M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

## 3.12 DRIP PANS

A. Provide drip pans under all fluid conducting piping which runs over electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.

B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.

C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

## 3.13 FIRE SAFING

A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

## 3.14 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.

B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.

C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.

D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

## 3.15 DRAIN LINES

A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to drain or to termination indicated. Drain lines to be galvanized pipe or Type M hard copper.

## 3.16 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.

B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.

C. When any air-handling equipment is used for temporary heat, the filters (MERV 13) shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned by HEPA vacuum and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer. If project is LEED provide additional MERV 8 filter overall return grilles to prevent debris from entering. Tape around perimeter edge to seal to grille.

D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain, and be put into first class working order before acceptance by the Owner.

E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

## 3.17 EXISTING PIPES AND MECHANICAL EQUIPMENT TO BE REMOVED

A. Where existing mechanical equipment, fixtures and/or piping is to be removed and/or relocated, all piping shall be disconnected and capped. All existing piping and hangers not to remain in use shall be removed completely to an existing main that is to remain in use, and capped at the main. General Contractor shall do all cutting, patching, and restoring that may be required for the removal of this piping and equipment. Where it is not possible to remove branch piping not remaining in use, due to its being concealed in the structure, the Division 23 Contractor shall cap the piping concealed at both ends in these areas as approved by the Architect.

B. All mechanical equipment, fixtures, and piping to be removed and not re-used shall remain the property of the Division 23 Contractor for credit to the contract price except as noted otherwise.

**END OF SECTION**

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# SECTION 23 0540

# MECHANICAL SOUND AND VIBRATION CONTROL

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. Requirements: Provide Mechanical Sound and Vibration Control in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 232113 - HVAC Piping & Specialties
Section 233300 - Ductwork and Accessories - Flexible Ductwork Connections

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Support isolation for motor/driven mechanical equipment.
2. Rails or beams for distribution of equipment loading to isolation units.
3. Fabricated bases for distribution of equipment loading to isolation units.
4. Inertia base frames in conjunction with equipment isolation.
5. Isolation of pipes and ductwork.
6. Sound attenuating units.
7. Sound-linings.
8. Sound proofing of construction.
9. External sound proofing.

### 1.3 QUALITY ASSURANCE

A. The Division 23 Contractor shall be responsible for assuring that all the following sound pressure level criteria are met. Sound pressure level tests shall be carried out by the Section 230593 Contractor in compliance with the Section 230593 specifications.

B. Acoustical Criteria:

1. Noise levels due to equipment and ductwork to permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC curves:

All occupied spaces ---------- RC-35

except

Occupied spaces within 15 foot radius from mechanical rooms, main supply and return duct shafts ---------- RC-40

Lobbies, Toilets, Commons Area ---------- RC-40

Office ---------- NC-30

Workout Rooms ---------- NC-30

Mechanical Rooms ---------- RC-60-80

Telecommunications Room (24-hour cooling req'd)---- NC-30

C. Mechanical Acoustical Performance:

1. Air Distribution system equipment terminal device noise:

a. Maximum permissible discharge sound-power levels in octave bands of airborne transmission through the terminal units or related pressure reducing devices, when operated in installed condition per Drawings and Specifications shall be as per Table 1, following:

| TABLE 1 - Maximum PWL (dB re 10E-12 Watt) | | | | |
|---|---|---|---|---|
| Octave Band | RC-30 | RC-35 | RC-40 | RC-45 |
| 1 | 54 | 59 | 64 | 69 |
| 2 | 68 | 73 | 78 | 83 |
| 3 | 61 | 66 | 71 | 76 |
| 4 | 59 | 64 | 69 | 74 |
| 5 | 51 | 56 | 61 | 66 |
| 6 | 48 | 53 | 58 | 63 |
| 7 | 39 | 44 | 49 | 54 |

2. Pressure reducing variable air volume boxes radiated noise:

   a. Maximum permissible radiated sound-power levels in octave bands when operated in an installed condition over occupied spaces, shall be as per Table 2 following:

| TABLE 2 - Maximum PWL (dB re 10E-12 Watt) | | | | |
|---|---|---|---|---|
| Octave Band | RC-30 | RC-35 | RC-40 | RC-45 |
| 1 | 54 | 59 | 64 | 69 |
| 2 | 62 | 67 | 72 | 77 |
| 3 | 58 | 63 | 68 | 73 |
| 4 | 55 | 60 | 65 | 70 |
| 5 | 53 | 58 | 63 | 68 |
| 6 | 50 | 55 | 60 | 65 |
| 7 | 46 | 51 | 56 | 61 |

3. Motor Acoustical Performance:

   a. Motor drives for pumps when installed per Drawings and Specifications shall operate with noise levels not exceeding 90dbA.
   b. Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.

4. Refrigeration Machine Cooler, Condenser, Compressor and Compressor Piping Acoustical Performance:

   a. The maximum permissible noise levels under design operating conditions, when measured in accordance with the methods and qualifications specified herein shall not exceed 90 dbA.

## 1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract.

   1. Each type of isolator including spring diameters, deflections, compressed spring height and solid spring height.
   2. Sound Attenuators.
   3. Sound Lining.
   4. Inertia Bases.

B. Test Reports: Submit certified test reports showing compliance in accordance with General Conditions of the Contract of the following items:

   1. Pressure drop and insertion loss ratings for sound attenuators.
   2. Certification that sound lining meets erosion test method described in UL Publication No. 181.

## PART 2 - PRODUCTS

### 2.1 PIPING AND EQUIPMENT ISOLATION

A. Manufacturer: Mason Industries, Inc., Vibro-Acoustics.

B. Other acceptable manufacturers offering equivalent products: Korfund, Amber/Booth Co., Vibration Mountings and Control Co., Kinetics.

C. Neoprene Mounting Pads (Specification Schedule Type 1)

1. Kinetics Noise Control Type NPD.
2. Minimum static deflection 0.04” for 0.22” thick pad.
3. Cross, double ribbed elastomer in-shear pads, capable of 60 or 120 PSI loading, depending on load density of equipment being isolated.
4. Material thickness as required to provide minimum deflections listed in table at end of the specification section.

D. Double Deflection Neoprene Mountings (Specification Schedule Type 2)

1. Mason Industries Type ND Mounting, Type DNR Rails.
2. Minimum static deflection 0.35 inch.
3. Bolt holes where required.
4. Steel rails above mountings to compensate for overhang where required.

E. Spring Isolator Mountings (Specification Schedule Type 3)

1. Mason Industries Type SLF.
2. Free-standing, laterally stable without housing, complete with 1/4 inch neoprene acoustical friction pads between base plate and support and with leveling bolts that must be rigidly bolted to equipment.
3. Spring diameters no less than 0.8 of the compressed height of the spring at rated load.
4. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

F. Restrained Spring Isolator Mountings (Specification Schedule Type 4)

1. Mason Industries Type SLR.
2. Spring isolator mounting equal to Type SLF but with housing that includes vertical resilient limit stops to prevent spring extension when weight is removed from equipment.
3. Provide hot dipped galvanized mountings exposed to weather.

G. Vibration Hangers (Specification Schedule Type 6)

1. Mason Industries Type DNH.
2. Spring and double deflection neoprene element in series.
3. Neoprene element minimum deflection 0.35 inch.
4. Spring diameters no less than 0.8 of compressed height of spring at rated load.
5. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

H. Integral Structural Steel Base (Specification Schedule Type B)

1. Mason Industries Type WF.
2. Rectangular for equipment other than "T" or "L" shaped pump bases.
3. Pump bases for split case pumps to include supports for suction and discharge base ells.
4. Beams for perimeter members minimum depth equal to one tenth of the longest dimension of the base. Depth need not exceed 14 inches if deflection and misalignment is kept within acceptable limits by manufacturer.
5. Provide height saving brackets to provide a clearance of one inch.

I. Steel Rail Base (Specification Schedule Type B)

1. Mason Industries Type ICS.
2. Steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base.
3. Provide members sufficiently rigid to prevent strains in the equipment.

J. Concrete Inertia Bases (Specification Schedule C)

1. Mason Industries Type K.
2. Rectangular structural beam or channel concrete forms for floating foundations.
3. Provide bases for split case pumps large enough for suction and discharge base ells supports.
4. In general, unless shown otherwise on the Drawings, provide bases with a minimum depth of one twelfth of the longest dimension of the base, but not less than 6 inches.
5. Forms to include minimum concrete reinforcement consisting of 1/2 inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as is required by the structural conditions.
6. Forms furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
7. Provide height saving brackets to maintain a 1 inch clearance below base.

K. Flexible Butyl Hose Pipe Connectors (Up to 2")

1. Mason Industries Type RMM.
2. Flexible Butyl 150 lb. hose with brass screw type ends attached by expansion or swedging methods. Clamps are unacceptable.
3. Duty up to: 100 psi and 220 deg. F.
4. Hoses up to 1-1/4 inches shall be 12 inches in length and 1-1/2 inches to 2 inches shall be 18 inches in length.

L. Flexible Neoprene Sphere Pipe Connectors (2" to 12")

1. Mason Industries Type MFNC and Type MFTNC.
2. Neoprene single-sphere type with 150 lb. ASA steel floating flanges.
3. Duty up to: 150 psi and 230 deg. F.
4. Movement limits: minimal 3/8 inch axial compression, 1/4 inch axial elongation, 3/8 inch lateral movement and 15 deg. angular movement.

M. Braided Flexible Connectors (Drawing Code "FC")

1. Manufacturer: Thermo Tech, Inc., Metraflex, Flex-Hose Co., Flexicraft Industries, Flex-Precision ltd., Twin City Hose.
2. Flexible connectors manufactured of 300 series stainless steel convoluted metal bellows and braid, 150 psig ASA drilled flanges. Maximum permanent offset from centerline = ¾". Maximum intermittent offset from centerline = 3/8".
3. Pressure test to be certified for 300 psi at 250 deg. F.
4. Schedule:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Make: Metraflex | | | | | | | | | |
| Model: SLP | | | | | | | | | |
| Size: | 1-1/2" | 2" | 2-1/2" | 3" | 4" | 6" | 8" | 10" | 12" |
| Connector Length: | 6" | 6" | 10-1/4" | 10-5/8" | 11-3/4" | 14-1/8" | 15-3/8" | 12-3/4" | 18-3/8" |
| Max Pressure: 300 psig | | | | | | | | | |
| Max Temperature: 250 deg. F | | | | | | | | | |

N. Acoustical Pipe Riser Anchors:

1. Mason Industries Type ADA.
2. All directional acoustical pipe anchor.
3. Minimum 1/2 inch thickness of heavy duty neoprene and duct isolation material.
4. Vertical restraints in either direction.

## 2.2 SOUND ATTENUATORS

A. Acceptable Manufacturers: SEMCO Manufacturing, Industrial Acoustics Company, Dynasonics, Acoustifoil Noise Control Products, Koppers, Rink, Commercial Acoustics, Vibro-Acoustics, Price.

B. Factory prefabricated.

C. Shell:

1. Galvanized Steel: 22 ga. minimum.
2. Leakproof at pressure differential of 8 in. w.g.

D. Media:

1. Flamespread: Maximum 25.
2. Fuel contributed and smoke developed: Maximum 50.
3. Maximum 4.5 lbs. per cubic foot density glass or mineral fiber packed under 5 percent compression.
4. Filler to be inert, vermin and moisture proof.
5. Non-erosive and non-pregnable.

E. Internal Construction:

1. Galvanized perforated steel baffles: Minimum 24 gauge.
2. Cleanable construction.

F. Net Insertion Ratings:

1. Determined by duct-to-reverberant room test method at design airflow shall be as per Table 3 following:

| TABLE 3 | | | |
|---|---|---|---|
| Band No. | Band Center Freq. (HZ) | Sound Trap Dynamic Insertion Loss(db) | |
| | | 5 Feet | 3 Feet |
| 1 | 63 | 6 | 4 |
| 2 | 125 | 10 | 7 |
| 3 | 250 | 18 | 12 |
| 4 | 500 | 30 | 19 |
| 5 | 1000 | 42 | 23 |
| 6 | 2000 | 34 | 23 |

G. Maximum self-generated noise at 2000 ft. per minute face velocity shall be as per Table 4 following:

| TABLE 4 - Sound Trap Self-Noise Level | | |
|---|---|---|
| Band No. | Band Center Freq. (HZ) | Sound Trap Self-Noise (db re 10E-12W) 5 ft. & 3 ft. |
| 1 | 63 | 63 |
| 2 | 125 | 54 |
| 3 | 250 | 52 |
| 4 | 500 | 50 |
| 5 | 1000 | 47 |
| 6 | 2000 | 48 |

## 2.3 SOUND LININGS

A. Acceptable Manufacturer: Johns Manville Permacote, Linacoustic and Spiracoustic.

B. Other acceptable manufacturers offering equivalent products: Knauf, CertainTeed ToughGuard R.

C. Product: Fibrous glass, acrylic surface coating, stenciled NFPA, conforming to ASTM C1071, ASTM G21 and ASTM G22.

D. Minimum thickness: As indicated in Part 3 of this specification.

E. Sound Absorption Coefficient for 1" thickness per the following:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frequency (cps) | = | 125 | 250 | 500 | 1000 | 2000 | 4000 | NRC |
| Coefficient | = | 0.09 | 0.29 | 0.65 | 0.78 | 0.83 | 0.80 | 0.70 |

F. Flamespread: Maximum 25.

G. Fuel contributed and smoke developed: Maximum 50.

H. Suitable for duct velocity of 5000 fpm. Lining shall meet erosion test method described in UL Publication No. 181.

I. Dynamic loss coefficient: Maximum 1.2.

J. Thermal conductivity 0.25 Btu/hr/deg F/in. @ 75°F mean temperature.

K. Provide additional facing for protection of acoustical liner at plenum fan discharge plenum in field-built, single wall fan plenums and where shown on drawings. Liner shall be 26 gauge steel with perforated 28% minimum open area.

## 2.4 ADHESIVE AND SEALER

A. Acceptable Products: Adhesive, Benjamin Foster "81-99", or accepted equal, Sealer, Benjamin Foster "82-07" or accepted equal.

B. In conformance with NFPA 90A.

C. Flamespread: Maximum 25.

D. Fuel contributed and smoke developed: Maximum 50.

## 2.5 NON-HARDENING CAULKING

A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.

B. Guaranteed to be permanently elastic.

## 2.6 VIBRATION DAMPERING COMPOUND

A. Acceptable Manufacturers: Soundcoat GP-1 Vibration Damping Compound, Korfund Dynamics Corporation Vibro-damp 80A, Kinetics, Vibro-Acoustics.

B. Non-burning.

C. Compound shall effectively damp vibrations for a broad frequency range between 10 Hz to 20 kHz.

D. Decay rate Geiger plate 45 dB/sec. at 72 deg. F.

## 2.7 EXTERNAL SOUND BARRIER INSULATION

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per $ft^2$ mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth,

quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1, Transmission loss when attached to outside of piping shall be as per the following table:

| Band No. | Band Center Freq. (Hz) | Transmission Loss (dB) |
|---|---|---|
| 1 | 125 | 13 |
| 2 | 250 | 16 |
| 3 | 500 | 24 |
| 4 | 1000 | 33 |
| 5 | 2000 | 43 |
| 6 | 4000 | 49 |
| - | STC | 28 |

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

## 2.8 EXTERNAL SOUND BARRIER INSULATION (PIPING)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per $ft^2$ mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

| Band No. | Band Center Freq. (Hz) | Transmission Loss (dB) |
|---|---|---|
| 1 | 125 | 13 |
| 2 | 250 | 16 |
| 3 | 500 | 24 |
| 4 | 1000 | 33 |
| 5 | 2000 | 43 |
| 6 | 4000 | 49 |
| - | STC | 28 |

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

## 2.9 EXTERNAL SOUND BARRIER INSULATION (SHEET METAL)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per $ft^2$ mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

| Band No. | Band Center Freq. (Hz) | Transmission Loss (dB) |
|---|---|---|
| 1 | 125 | 13 |
| 2 | 250 | 16 |
| 3 | 500 | 24 |
| 4 | 1000 | 33 |
| 5 | 2000 | 43 |
| 6 | 4000 | 49 |
| - | STC | 28 |

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

# PART 3 - EXECUTION

## 3.1 GENERAL - PIPING AND EQUIPMENT ISOLATION

A. Unless otherwise noted on the Equipment Mounting Schedule, provide mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators to be selected in accordance with the weight distribution so as to produce reasonable uniform deflection. Deflections to be as noted on the Equipment Mounting Schedule included at the end of this section. All motorized equipment will at a minimum have spring vibration isolators and resilient duct and pipe connections.

B. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following the isolation work, to avoid any contact which would reduce the vibration isolation.

C. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a

rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.

D. Support the machine to be isolated with a structural steel frame.

E. Provide brackets to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket to be recommended by the isolator manufacturer.

F. For restrained spring isolators, use housing as blocking during erection so that installed and operating heights can be the same. Maintain a minimum clearance of 1/2 inch around restraining bolts between housing and spring to avoid interference with spring action. Limit stops to be out of contact during normal operation.

## 3.2 HANGERS

A. Install type 2 or 3 vibration isolation piping hangers where indicated in Equipment Mounting Schedule at the end of this section and within 20 feet (measured along piping) upstream and downstream of all pumps 3 HP or larger.

B. Install the isolators with the isolator hanger box attached to or hung as close as possible to the structure.

C. Suspend the isolators from substantial structural members, not from slab diaphragm unless specifically accepted.

D. Align hanger rods to clear hanger box.

## 3.3 EQUIPMENT BASES

A. Provide minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor of 1 inch. Provide minimum operating clearance between concrete inertia base and the housekeeping pad or floor of 1 inch.

## 3.4 COIL BASES

A. Mount floor supported coil section on a 1/4" thick layer of ribbed neoprene pad, with a 16 gauge galvanized steel plate between coil frame and pad. Coil shall be mounted on a concrete curb of sufficient height to allow coil drain pan to be sloped in two directions to drain pan bottom outlet with P-trap and/or refrigerant suction line traps to be installed without hitting floor.

## 3.5 FLEXIBLE PIPING CONNECTORS

A. Provide flexible connectors for equipment that is supported by or mounted on vibration isolators except when connected piping is made up with a Victaulic Flex coupling system. Connectors to be installed under Section 232113.

B. Hoses shall be installed on the equipment side of the shut-off valves and horizontally wherever possible.

C. Provide connectors at pump suction and discharge, and elsewhere as required to accommodate thermal expansion, vibration and misalignment.

D. Provide flexible connectors on all suction and discharge connections to all base mounted centrifugal pumps, vertical turbine pumps, air compressors, dryers, vacuum pumps or other equipment items producing vibration, shock, noise, or thermal motion of piping.

E. Provide 300 psi companion flanges for connector for threaded, welded, soldered, or brazed piping as appropriate.

F. Connectors to be aligned, centered, and shall not bear weight of pipe, fittings, or pipeline accessories such as valves. Piping shall be supported both sides of horizontal or vertical connectors.

## 3.6 PIPE FLOOR SUPPORTS

A. Provide type 3 mountings with a minimum static deflection of 1.5 inches on horizontal pipe floor supported at slab in equipment rooms above grade.

## 3.7 SOUND ATTENUATORS

A. Install in accordance with manufacturers' recommendations to obtain published performance.

B. After installation, measure total system pressure before and after attenuators.

C. If pressure loss exceeds maximum static pressure loss schedules on drawings: modify entrance or discharge aerodynamic flow to obtain specified performance.

D. For maximum structural integrity, sound attenuator baffles should be installed in a vertical position; where this is not possible, structural reinforcement is required for attenuators wider than 24 in.

E. When elbows precede attenuators, baffles shall be parallel to the plane of the elbow radius.

## 3.8 SOUND LININGS

A. Dimensions of lined ductwork are clear inside dimensions after lining has been installed.

B. Sound linings to be held in place with mechanical fasteners as per the latest SMACNA duct liner application standard, with joints and any tears to be coated with Benjamin Foster or accepted equal adhesive. The transverse joints to be coated prior to installation so that the ends of the liner are compressed together while the adhesive is still moist, forming a seal of the leading and trailing edge of each joint. Excess adhesive to be brushed to an even finish over the joint.

C. Provide continuous sheet metal edge protectors at entering and leaving edges of lined duct sections where adjacent to unlined duct sections.

D. Extent of 1” ductwork sound linings:

1. Upstream of toilet/general exhaust fans and relief air fans, a minimum distance of 20'-0".
2. Downstream of VAV boxes.

3. Transfer air ducts and shaft return stub ducts.
4. In low pressure supply, return and rectangular exhaust ducting.
5. Return air elbow boots over ceiling grilles.
6. In plenums above supply diffusers.
7. Elsewhere when specifically indicated on drawings.
8. Do not install liner in duct serving evaporative cooled systems 10’-0” downstream of media.

E. Extent of plenum sound linings:

1. Mixed and outside air plenum walls and ceilings.
2. Supply air discharge and filter plenum walls and ceiling.
3. Return/Exhaust air plenums.
4. Return air plenum from riser to mixed air plenum.
5. Return/Exhaust air plenums inside packaged rooftop units when not factory installed.

## 3.9 SOUND PROOFING OF CONSTRUCTION

A. Required for opening between ductwork and piping and following construction:

1. Equipment room walls.
2. Floors, except in shafts.
3. Roofs, specifically inside roof curbs for mechanical equipment and where ductwork penetrates roof deck.

B. Sound proofing:

1. Fill openings with tightly packed fibrous glass blanket or board for full depth of penetration.
2. Caulk each side of opening with non-hardening, non-aging caulking compound.

## 3.10 EXTERNAL VIBRATION DAMPENING

A. For typical floor supply duct take-offs from main supply riser when required to meet specified sound levels, provide 1/8 inch thick duct exterior coating of vibration dampening compound. These treatments to be provided over the rectangular portion (flat sides) of the floor take-off ducts.

## 3.11 EXTERNAL SOUND BARRIER INSULATION

A. Provide foam composite, applied over the vane axial fan casings (both supply and return) extending from the inlet side of the intake sound traps, to the leaving side of the discharge sound traps, inclusive of all flexible connectors.

B. Provide a duct enclosure of 2 layers of 5/8" gypsum board with staggered seams extending from the point that the ducts leave the rooftop unit or fan plenum to the leaving side of the discharge sound trap(s). A minimum clearance of 1" shall be maintained between the ductwork and the enclosure walls; all voids between the enclosure and the ductwork to be filled with loose batt fiberglass insulation. The points at which the ductwork penetrates the enclosure; the sheetrock is to be cut away from the ductwork by 1/4" to 1/2" and the void is to be filled with non-hardening caulk. Caulk shall be fire-rated if enclosure is required to be fire-rated.

## 3.12 EQUIPMENT MOUNTING SCHEDULE

A. Manufacturer: Mason Industries, Inc., Kinetics, Vibro-Acoustics.

B. Schedule: See the following pages.

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | SLAB ON GRADE | | | 20 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PUMPS | | | | | | |
| A. Close Coupled | | | | | | |
| 1. Up to 7 1/2 HP | B/C | 2 | .25 | C | 3 | .75 |
| 2. 10 HP & Over | C | 3 | .75 | C | 3 | .75 |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | SLAB ON GRADE | | | 20 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PUMPS | | | | | | |
| A. Flexible Coupled | | | | | | |
| 1. Up to 40 HP | C | 3 | .75 | C | 3 | .75 |
| 2. 50 to 125 HP | C | 3 | .75 | C | 3 | .75 |
| 3. 150 HP & Over | (See Note 1) | | | (See Note 1) | | |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | SLAB ON GRADE | | | 20 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| CENTRIFUGAL FANS & VENTILATION SETS | | | | | | |
| A. Up to 22 in. Wheel dia. | A/B | 2 | .25 | A/B | 3 | .75 |
| B. 24 in. Wheel dia. & Over | | | | | | |
| 1. Up to 50 hp | | | | | | |
| a. Up to 300 RPM | (See Note 2) | | | (See Note 2) | | |
| b. 301 to 500 RPM | B | 3 | 1.5 | B | 3 | 1.5 |
| c. 501 RPM & Over | B | 3 | .75 | B | 3 | .75 |
| 2. 60 HP & Over | | | | | | |
| a. Up to 300 RPM | (See Note 2) | | | (See Note 2) | | |
| b. 301 to 500 RPM | B/C | 3 | .75 | C | 3 | 1.5 |
| c. 501 RPM & Over | B/C | 3 | .75 | C | 3 | 1.5 |
| PACKAGED AIR HANDLING EQUIPMENT | | | | | | |
| A. Up to 10 HP | A | 2 | .25 | A | 3 | .75 |
| B. 15 HP & Over | A | 2 | .25 | A | 3 | .75 |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | SLAB ON GRADE | | | 20 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PACKAGED ROOFTOP AIR CONDITIONING UNIT | -- | -- | -- | D | 3 | .75 |

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 2007 EDITION).

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | 30 FT. FLOOR SPAN | | | 40 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PUMPS | | | | | | |
| A. Close Coupled | | | | | | |
| 1. Up to 7 1/2 HP | C | 3 | .75 | C | 3 | .75 |
| 2. 10 HP & Over | C | 3 | 1.5 | C | 3 | 1.5 |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | 30 FT. FLOOR SPAN | | | 40 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PUMPS | | | | | | |
| A. Flexible Coupled | | | | | | |
| 1. Up to 40 HP | C | 3 | 1.5 | C | 3 | 1.5 |
| 2. 50 to 125 HP | C | 3 | 1.5 | C | 3 | 2.5 |
| 3. 150 HP & Over | (See Note 1) | | | (See Note 1) | | |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | 30 FT. FLOOR SPAN | | | 40 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| CENTRIFUGAL FANS & VENTILATION SETS | | | | | | |
| A. Up to 22 in. Wheel dia. | A/B | 3 | .75 | A/C | 3 | .75 |
| B. 24 in. Wheel dia. & Over | | | | | | |
| 1. Up to 50 hp | | | | | | |
| a. Up to 300 RPM | (See Note 2) | | | (See Note 2) | | |
| b. 301 to 500 RPM | B | 3 | 1.5 | B | 3 | 2.5 |
| c. 501 RPM & Over | B | 3 | .75 | B | 3 | 1.5 |
| 2. 60 HP & Over | | | | | | |
| a. Up to 300 RPM | (See Note 2) | | | (See Note 2) | | |
| b. 301 to 500 RPM | C | 3 | 2.5 | C | 3 | 2.5 |
| c. 501 RPM & Over | C | 3 | 1.5 | C | 3 | 2.5 |
| PACKAGED AIR HANDLING EQUIPMENT | | | | | | |
| A. Up to 10 HP | A | 3 | .75 | A | 3 | .75 |
| B. 15 HP & Over | A | 3 | 1.5 | A | 3 | 1.5 |

| EQUIPMENT VIBRATION ISOLATION SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| EQUIPMENT TYPE | 30 FT. FLOOR SPAN | | | 40 FT. FLOOR SPAN | | |
| | BASE TYPE | ISOL TYPE | MIN. DEFL. (IN.) | BASE TYPE | ISOL TYPE | MIN DEFL. (IN.) |
| PACKAGED ROOFTOP AIR CONDITIONING UNIT | A/B | 3 | 1.5 | A/B | 3 | 2.5 |

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 2007 EDITION).

**END OF SECTION**

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# SECTION 23 0548

# MECHANICAL SEISMIC CONTROL

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Anchorage and seismic restraint systems for all Division 23 isolated and non-isolated equipment, ductwork and piping systems.

B. Equipment/piping/ductwork to be isolated and/or seismically supported shall include but not be limited to the following:

1. Piping
2. Ductwork
3. Sound Attenuators
4. Unit Heaters
5. Radiant Ceiling Panels
6. Air Separators / Dirt Separators
7. Expansion Tanks
8. Supply Air Fans
9. Hanging Exhaust Fans
10. Pumps
11. Heat Exchangers
12. Air Handling Units
13. Domestic Water Heaters

### 1.2 RELATED WORK

A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230540 - Mechanical Sound and Vibration Control.

### 1.3 REFERENCES

A. International Building Code, Current Edition in use by Jurisdictional Authority.

B. NFPA Bulletin 90A, Current Edition.

C. UL Standard 181.

D. Tri-Services Manual, Fagel Et Al, 1973.

E. SMACNA Seismic Restraint Manual: Guidelines for mechanical systems.

## 1.4 SYSTEM DESCRIPTION

A. The Division 23 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Occupancy Category III
2. Short period design spectral response acceleration coefficient SDS= 0.93
3. One-second period design spectral response acceleration coefficient SD1=0.58
4. Site Class D
5. Seismic Design Category D.

B. The following components have a component importance factor IP of 1.5:

1. Fire Sprinkler Protection System.

All other components have an importance factor IP of 1.25.

## 1.5 QUALITY ASSURANCE

A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment. Shop drawings included with deferred submittal for earthquake bracing and anchors from the restraint manufacturer shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 23 equipment and systems shall be provided by a single firm.

B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect/Engineer for this project.

C. Seismic Engineer or the Engineer’s Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer’s design. A certificate of compliance bearing the Seismic Engineer’s signed Professional Engineer’s seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.

D. The Division 23 Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases/skids/curbs designed to receive seismic bracing and/or anchorage. All isolated and non-isolated mechanical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

## 1.6 SUBMITTALS

A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 23 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.

B. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

1. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Paragraph 1.1 above, and as detailed on drawings.
2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
3. Details for all seismic bracing.
4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
7. Include confirmation that all calculations are based on the design criteria listed in Paragraph 1.4.A of this Section.
8. Certificate of Compliance.

## PART 2 - PRODUCTS

### 2.1 RESTRAINT EQUIPMENT AND SYSTEMS

A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

1. Mason Industries, Inc.
2. Korfund
3. Amber/Booth Company
4. Vibration Mountings and Control Company
5. Kinetics
6. International Seismic Application Technology
7. Tolco
8. Vibro-Acoustics
9. Hilti

B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment in accordance with Section 230540.

### 2.2 SNUBBERS

A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.

C. Snubbers shall be Mason Industries Z - 1011 or accepted equivalent.

## PART 3 - EXECUTION

### 3.1 DESIGN AND INSTALLATION

A. General:

1. All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein. The following mechanical components are exempt from seismic restraint requirements:

    a. Components in Seismic Design Categories A and B (see 1.4-A-5 above).
    b. Components in Seismic Design Category C (see 1.4-A-5 above) that have an importance factor $I_P$ of 1.0 (see 1.4-B above).
    c. Components that have an importance factor $I_P$ of 1.0 (see 1.4-B above), that are mounted less than four feet above the floor, that weigh less than 400 pounds, and that have flexible ductwork, piping, and conduit connections.
    d. Components that have an importance factor $I_P$ of 1.0 (see 1.4-B above), that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.

2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.
3. Attachments and supports for mechanical equipment shall meet the following provisions:

    a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).

    b. Friction clips shall not be used for anchorage attachment.

    c. Expansion anchors shall not be used for mechanical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.

    d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.

    e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.

    f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as $2F_p$. The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.

g. Seismic supports shall be constructed so that support engagement is maintained.

B. Install ceiling mounted items in accordance with ASTM C 636.

1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Spring Isolated Equipment:

1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

D. Non-Isolated Equipment:

1. The Division 230548 Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.04 of this specification section.

E. Piping:

1. Seismic braces for piping may be omitted when the distance from the top of the pipe to the supporting structure is 12" or less.
2. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
3. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
4. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
5. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

F. Ductwork:

1. Seismic restraints are not required for HVAC ducts with importance factor $I_P$ of 1.0, provided that either of the following conditions are met for the full length of each duct run:

   a. HVAC ducts are suspended from rod hangers and hangers are 12 inches or less in length from the point rod attaches to duct, to the point rod connects to the supporting structure. Rods must be secured to both top and bottom cross angles with locking nuts above and below angle iron.
   b. HVAC ducts have a cross-sectional area of less than 6 square feet.
   c. This exception is not valid if the top of ductwork is not secured to hanger rods to limit pendulum length to 12 inches.

2. Equipment items installed in-line with the duct systems with an operating weight greater than 75 pounds shall be supported and laterally braced independently of the duct system.

**END OF SECTION**

# SECTION 23 0593

# TESTING, ADJUSTING AND BALANCING

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these Documents.

B. TAB will be responsible to carry out the commissioning requirements specified in other sections.

C. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230593 - Ductwork and Accessories
Section 230800 – Commissioning of HVAC

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Upon completion of the installation of all the plumbing, air and heating or cooling water systems and steam heating systems, all necessary adjustments shall be made to provide capacities listed on the Drawings to properly balance these systems. Coordinate all test and balancing activities and sequencing with WSU facilities, Jake
2. Submittals and written reports as specified.
3. Testing requirements as described in Specification Section 230500, paragraph 1.16.
4. Witness duct leakage test required by Specification Section 233300 – Ductwork and Accessories.
5. Provide assistance, in cooperation with the various trades, in the final adjustments and test of the Life Safety Systems to comply with the requirements of the local Building and Fire Departments.
6. Provide Owner training as described in Specification Section 230500.
7. Contract to be carried by General Contractor.

### 1.3 QUALITY ASSURANCE

A. Work under this section shall be executed under the direct supervision of a Registered Professional Engineer having an established professional office in the State of Utah and having an experience record of not less than five (5) years in the mechanical contracting industry, engaged in testing, balancing and adjusting of air and hydronic mechanical systems for not less than two (2) years of that time, or, under the direct supervision of a qualified testing, adjusting and balancing supervisor, possessing certification from the National Environmental Balancing Bureau (NEBB) or from the Associated Air Balance Council (AABC).

B. Comply with the applicable procedures in the chapter on Testing, Adjusting and Balancing in the latest ASHRAE Edition of the NEBB, AABC, and SMACNA Test and Balance documents.

C. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations, and calibration histories for each instrument shall be included with the final report.

D. Accuracy of measurements shall be in accordance with the applicable measurement means as listed in the latest edition of NEBB, AABC, and SMACNA Test and Balance documents.

E. Allowable Tolerances:

1. Tolerances of adjustment for air handling systems are plus or minus 5% for supply systems at air devices and plus or minus 10% for return and exhaust systems from figures shown on drawings.
2. Tolerances of adjustment for hydronic systems, are plus or minus 10% of design conditions shown on drawings.

F. Final Testing, Adjusting and Balancing of all hydronic and air systems shall be performed by an approved separate professional (working under the General Contractor) Testing, Adjusting and Balancing subcontractor meeting the above Quality Assurance requirements (working under the General Contractor). Acceptable separate professional subcontractors meeting the above requirements are as follows:

1. BTC Services, Inc.
2. Certified Testing & Balancing, Inc.
3. Bonneville Test & Balance
4. RS Analysis, Inc.
5. Danis Test & Balance, Inc.
6. Independent Test & Balance, LLC
7. Intermountain Test & Balance

G. Subcontractors not listed above must submit for acceptance.

H. The Contractor will provide the services of a qualified test and balance contractor. The qualifications of the TAB contracting firm shall be submitted, along with the specific qualifications of the lead site technician who will remain on site during all TAB work, within 10 days of notice to proceed. Recent projects shall be listed and described for both the company and the lead technician. Names and telephone numbers of the project contractors and facility managers will be provided.

I. The owner must approve in writing the qualification of both the company and the lead technician.

J. Within 30 days after execution of the Owner-Contractor Agreement, transmit to Architect/Engineer the name and qualifications of the organization proposed to perform the services.

## 1.4 SUBMITTALS

A. Procedure: Submit Qualifications, Documentation, Test Schedules and Reports in accordance with the General Conditions of the Contract:

B. Qualifications:

1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

   a. Organization supervisor and personnel training and qualifications.
   b. Specimen copy of each of the report forms proposed for use.

C. Preliminary Report: At least fifteen days prior to starting field work, submit three copies of:

1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.

2. A complete list of instruments proposed to be used, organized in appropriate categories, with data-sheets for each. Show:

   a. Manufacturer and model number.
   b. Description and use when needed to further identify the instrument.
   c. Size of capacity range.
   d. Latest calibration date.

3. Architect/Engineer will review submittals for compliance with Contract Documents, and will return one set marked to indicate:

   a. Discrepancies noted between measured data and Contract Documents.
   b. Additional, or more accurate, instruments required.
   c. Requests for re-calibration of specific instruments.

D. Schedules:

1. Schedule tests to comply with project completion schedules.
2. Schedule testing and balancing of parts of the systems which are delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor, as early as the proper conditions will allow, after consultation with Architect/Engineer.
3. Submit reports of delayed testing promptly after execution of those services.

E. Final Report: At least fifteen days prior to Contractor's request for final inspection, submit three copies of final reports, on applicable reporting forms, for review. Submit a fourth copy directly to the Engineer. Each individual final reporting form must bear the signature of the person who recorded data and that of the NEBB or AABC certified supervisor of the reporting organization. Identify instruments of all types which were used and last date of calibration of each. Report shall include:

1. A detailed letter to Engineer outlining all abnormal or notable conditions not covered in above data specifically identifying all locations where specified flow tolerances could not be met.
2. A set of reduced black and white or blueline prints with all air openings clearly marked to correspond with data sheets and with thermometer locations clearly marked.
3. Data sheets showing amount of air handled at each opening, instrument used, velocity readings, and manufacturer free area factor.

4. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the heating season. Logs shall be taken when outside temperature is 30 deg.F or colder.
5. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the cooling season. Logs shall be taken with full occupant load, full lighting, and maximum solar conditions.
6. Equipment data sheets giving make, size and model, of fans, starters and motors with rated amps and service factors, and drives. Include pumps, supply fans, exhaust and recirculating fans.
7. Operating data including fan RPM, inlet and outlet pressures, pressure drop across filters, face and bypass dampers, and measured motor current and voltage, BHP and CFM (total).
8. Heating equipment operating data including air temperatures entering and leaving heating coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperature entering and leaving heating coil, water flow and pressure drop through heating coil.
9. Cooling equipment operating data including air temperatures entering and leaving cooling coils together with corresponding air flow and air pressure drop, water temperature entering and leaving cooling coil, and water flow and pressure drop through cooling coil.
10. Cooling tower operating data including measurements of hot water, cold water and wet-bulb temperatures, circulating water flow rate, fan RPM, fan power and wind velocity.
11. Prime cooling equipment operating data including condenser and evaporator flow rate, entering and leaving water temperatures and corresponding chiller load percentage. Pressure drop through condenser evaporator.
12. Equipment and operating data as required to show performance of pumps, heat exchangers, domestic hot water circulating systems, heating, ventilating, and air conditioning units, cabinet heaters, unit heaters, unit ventilators, fans and temperature control devices.
13. Sound pressure levels showing readings in all 8 octave bands and plotted on RC(II) charts shall be submitted for the following:

    a. All sides of Mechanical Rooms.
    b. Lobbies, Toilets, and Commercial Area.
    c. Conference Rooms.
    d. Spaces within 20 ft. of parking garage ventilation fan inlets and outlets.
    e. All spaces exhibiting abnormally high or annoying noise levels.

14. Domestic hot water recirculation data including flow at each branch shown requiring specific flow, and at the pump.

## 1.5 PROJECT CONDITIONS

A. The following job conditions must be verified before any testing, adjusting or balancing of the environmental systems begin:

1. Installation of the designated system is complete and in full operation.
2. On hydronic systems, strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, and other such conditions requiring correction.
3. Air systems shall be checked for dirty filters, filter leakage, equipment vibrations, damper operation, fan rotation, and other such conditions requiring correction.

## PART 2 - PRODUCTS

**- NOT USED –**

## PART 3 - EXECUTION

### 3.1 PROCEDURE

A. Confirm that project conditions have been verified and that necessary corrections have been made before proceeding with the Work.

B. The Test and Balance Contractor must proportion air/water flows in the system while introducing a minimum amount of resistance. All systems are to be proportionally balanced.

C. Hydronic Systems:

1. Using system flow meters and/or contact pyrometer, the balancing firm shall adjust the quantity of water or glycol solution handled by each pump and supplied to each coil, solar collector, heat exchanger, cooling tower, and such other primary source equipment to meet design requirements, and mark each balancing cock at final setting.

D. Air Systems:

1. The balancing firm shall adjust all dampers, diffusers, registers, belts and sheaves for the delivery and distribution of air quantities shown in the Contract Documents and shall mark each balancing device at final setting.
2. Adjust fan speeds and motor drives within drive limitations for required air volume, provide new sheaves as necessary or adjustable bands on constant volume plenum fans, and notify Division 26 Contractor of any thermal overloads that need to be changed/replaced.
3. Measure static air pressure conditions on air supply units, including individual filter and coil pressure drops, and total pressure across the fan. Make allowances for 0.5” w.c., equivalent to 50% loading of filters.
4. Exhaust and recirculation air systems shall be adjusted for air quantities shown on Drawings.
5. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
6. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
7. Measure building static pressure in both economizer mode and minimum outside air mode, and adjust supply, return and exhaust air systems to provide the required relationship between each to maintain approximately 0.05 inches water column positive static pressure at the Building Entries.
8. Distribution system shall be adjusted to obtain uniform space temperatures free from objectionable drafts and noise.
9. Where multiple air diffusers are shown on one terminal box, adjust dampers for the delivery and distribution of air quantities shown in the Contract Documents.
10. Set all VAV boxes at minimum/maximum air flow shown on drawings.
11. Adjust air flow switches for proper operation on all fan powered VAV boxes.
12. Report: After all adjustments are made, a detailed report shall be prepared by the balancing firm and submitted to the Architect for approval. Owner reserves the right to spot check the report prior to final acceptance.

E. Plumbing System:

1. Hot Water Recirculation Systems: Set flow at each balancing valve shown. Record flow at each pump. Verify the proper installation of automatic flow control valves.

**END OF SECTION**

# SECTION 23 0700

# MECHANICAL INSULATION

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. Requirements: Provide insulation in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 224450 - Plumbing Equipment
Section 232113 - HVAC Piping & Specialties
Section 236400 - Refrigeration
Section 235700 - Heat Transfer
Section 233100 - Air Distribution

### 1.2 SYSTEM DESCRIPTION

A. The mechanical insulation work required by this Section shall include materials and methods as described herein and on the Drawings and as required by applicable energy codes.

B. The work includes, but is not limited to providing insulation on the following:

1. Plumbing Systems:

   Domestic Hot Water-Supply, Recirculating, Hot Water Converters, and Storage Tanks
   Tempered Domestic Water-Supply, Recirculating and Storage Tanks
   Tempered Domestic Water Circulating
   Domestic Cold Water
   Primary Roof Drain System
   Overflow Roof Drain Bowls
   Chilled Drinking Water Piping, Recirculating and Storage Tanks

2. Heating Systems:

   Heating Water Supply and Return
   Heat Exchangers, Converters and Air Separators
   Thermal Storage Tanks
   Steam Piping
   Gravity Steam Piping
   Pumped Steam Condensate

3. Chilling Systems:

Chilled Water
Chilled Water Pump Bodies
Air Separators
Condenser Water

4. Refrigerant Systems:

Refrigerant Piping
Cold Condensate Drains

5. Air Distribution Systems:

Exterior surfaces of all plenums and ducts which are a part of the following systems where duct or plenum is not lined (see Section 230540):
Outside Air
Combustion Air
Mixed Air
Medium Pressure Supply Air
Low Pressure Supply Air
Return Air
Rigid Round Runouts to Diffusers except any exposed in open ceilings.

6. Other Systems:

Cold Condensate Drains

## 1.3 QUALITY ASSURANCE

A. Qualifications: The firm executing the work of this Section shall have at least 3 years successful installation experience on projects with mechanical insulations similar in scope and nature to that required for this Project.

B. Requirements of Regulatory Agencies: All insulation shall be in accordance with Jurisdicational Building Code and State and Federal Energy Conservation Standards.

## 1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation in accordance with the General Conditions of the Contract. Include schedule showing manufacturer's product number, thickness and furnished accessories for each mechanical system requiring insulation.

B. Provide schedule of pipe sizes with insulation thickness at corresponding fluid temperatures.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver insulation, coverings, adhesives, and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.

B. Storage of Materials: Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of insulation materials shall be as follows:
Certain-teed
Owens-Corning
Johns Manville
Armstrong
Knauf
Dow Chemical
3M/Thermal Ceramics (FireMaster)
Unifrax (Fyrewrap)
SpecSeal (Claymac)
Renler (Pyroscat FastR Wrap)
Gilsulate International, Inc. (Gilsulate 500XR Loose-Fill Insulation)
Einsulation
Aerogels

### 2.2 MATERIALS

A. Conductivity:

| TYPE OF INSULATION | MAXIMUM THERMAL CONDUCTIVITY/INCH |
|---|---|
| Calcium Silicate | 0.47 at 600 degrees Fahrenheit |
| Glass Fiber Pipe Insulation | 0.25 at 75 degrees Fahrenheit |
| Glass Fiber Rigid Equipment Insulation | 0.25 at 75 degrees Fahrenheit |
| Glass Fiber Rigid Duct Insulation | 0.24 at 75 degrees Fahrenheit |
| Glass Fiber Blanket Duct Insulation | 0.29 at 75 degrees Fahrenheit |
| Expanded Polystyrene | 0.24 at 75 degrees Fahrenheit |
| Ceramic Fiber Grease Duct Wrap | 0.25 at 70 degrees Fahrenheit |
| Polyisocyanurate Foam | 0.19 at 75 degrees Fahrenheit |
| Granular Loose Fill | See below |

B. Duct Wrap: Blanket-type fiberglass insulation 1-1/2" thick, 0.75 pounds per cubic foot density.

C. Vapor Barrier Coatings: To have a perm rating not more than 0.25 when tested in accordance with ASTM E96, procedure A.

D. Adhesives, Sealers, Facings and Vapor Barrier Coatings: To be compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings as recommended by the manufacturer of insulation materials.

E. Chemicals for Treating Paper: Non-soluble.

F. Non-Collapsing Inserts: Calcium Silicate or Polyisocyanurate (Dow Trymer 2000). No Polystyrene inserts are allowed.

G. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

1. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F.
2. Application Temperature Range: 35 to 800 deg F.
3. Dry Density: 40 to 42 lb/cu. ft.
4. Strength: 12,000 lb/sq. ft.

## 2.3 PERFORMANCE CRITERIA

A. Insulation and accessory materials to meet the following criteria:

1. Insulation Materials: To be noncombustible as defined in National Fire Protection Association Pamphlet 220 and to be Underwriter's Laboratory listed.
2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

## 2.4 HANDICAP LAVATORY INSULATION

A. Insulation System: Molded closed cell insulation, 3/16-inch nominal wall thickness; provide pre-molded fittings to completely cover tail piece, P-trap, trap arm, hot and cold water supply stop valves and exposed supply tubing; include nylon fasteners for all fittings.

B. Handi Lav-Guard manufactured by Truebro; Trap Wrap manufactured by Brocar Products; Zeston Snap-Trap manufactured by Johns Manville or approved equal.

C. Install at all handicap accessible lavatories installed in this project.

# PART 3 - EXECUTION

## 3.1 GENERAL INSTALLATION REQUIREMENTS

A. Testing of piping and ductwork to be completed prior to application of insulation.

B. Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together.

C. Make insulation continuous through sleeves or openings in walls and floors.

D. Run sealed vapor barriers continuous throughout all cold surface insulation systems.

E. Avoid the use of staples on vapor barrier jackets. Seal all vapor barrier penetrations with white vapor barrier sealant.

F. Apply adhesives so as not to exceed the coverages recommended by the manufacturers.

G. Leave surfaces clean and ready for painting.

H. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to the edges of such openings and stop with sheet metal rings.

I. Provide non-collapsing inserts between pipe and all shields/saddles on all insulated piping 2-1/2" and larger.

## 3.2 SPECIFIC INSTALLATION REQUIREMENTS

A. Minimum Pipe Insulation Schedule:

2009 International Energy Conservation Code

| PIPE INSULATION THICKNESS IN INCHES* | | | |
|---|---|---|---|
| | Nominal Pipe Diameter | | |
| Fluid | ≤ 1.5” | > 1.5” | > 10” |
| Steam Condensate, Hot Water | 1.5 | 3.0 | 3.0 |
| Chilled Water, Refrigerant, Condenser Water Systems | 1.5 | 2.0 | 2.0 |
| Steam | 1.5 | 1.5 | 2.0 |

*Based on insulation having a conductivity not exceeding 0.27 BTU per inch/h·ft$^2$·°F.

Exceptions:

1. Factory installed piping within HVAC equipment tested and rated in accordance with 2009 IECC referenced procedures.
2. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F, unless noted to be insulated on drawings or in specifications.
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power, unless noted to be insulated on drawings or in specifications.
4. Runout piping not exceeding 4 feet in length and 1 inch in diameter between the control valve and HVAC coil.

| DUCT AND PLENUM INSULATION | |
|---|---|
| Location | Min. Insulation Value |
| In unconditioned spaces (i.e. ceiling spaces or unheated spaces) | R-5 |
| Outside building envelope | R-8 |

Exceptions:

a. When located within equipment.
b. When design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (i.e. return air ducts in ceiling spaces).

B. Plumbing System:

1. Domestic Cold Water:

1. Insulate entire system. Thickness per Table of Section 230700, 3.2.A. with colored PVC cover in mechanical rooms.

2. Roof Drains:

Horizontal mains and vertical from horizontal to and including drain bowls, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap. Overflow roof drain bowls shall be insulated but not overflow drain piping.

3. Domestic Hot and Tempered Supply and Circulating Water:

2. Insulate entire system with colored PVC cover in mechanical rooms.

Thicknesses per table of 230700-3.2, A.

4. Domestic Hot Water Heaters, Storage Tanks, and Accumulators (not factory insulated):

Two inch thick fiberglass board, foil faced or faced with Du-All tank wrap or equal. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant lagging adhesive.

5. Chilled Drinking Water:

Thicknesses per Chilled Water Piping System, 40-55 deg. F., of 230700-3.2 A.

6. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for return air plenum use.

7. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas and heavy coat of vapor barrier mastic coating.

C. Heating System:

1. Heating Water Supply and Return:

3. Fiberglass pipe covering with all-service jacket and self-seal lap on all piping with colored PVC cover in mechanical rooms.
   a.
   b. Thicknesses per Minimum Pipe Insulation Schedule in Section 230700-3.2, A.
   c. Heat exchangers, convertors, air separators, storage tanks and receivers:

      351 deg. and up ..... 4" thick
      251 deg. - 350 deg..... 3" thick
      up to 250 deg..... 2" thick

Fiberglass pipe covering or Du-All pipe and tank wrap with all service jacket. Finish with six-ounce canvas or fiberglass reinforcing mesh applied with heavy coat of lagging adhesive where subject to abuse.

2. Steam Piping Systems:

4. a. Fiberglass covering with all-service jacket and self-seal lap on all piping with colored PVC cover in mechanical rooms.

b. Thicknesses per Minimum Pipe Insulation Schedule.
c. Steam Condensate: Thickness per Steam Piping System of Section 230700- 3.2 A.
d. Boiler Feedwater: Thickness per Hot Water Piping System of Section 230700- 3.2 A.

3. Fittings:

a. Premolded PVC fitting covers with Fiberglass insert.

4. Valves:

a. All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

D. Chilling System:

5. Fiberglass pipe covering with all service jacket self-seal lap on all piping with colored PVC cover in mechanical rooms.

6. Chilled Water: Thicknesses per Chilled Water Piping System of Section 230700-3.2 A.

7. Condenser Water: Thicknesses per Condenser Water Piping System of Section 230700 – 3.2 A.

8. Fittings:

All systems: Premolded PVC fitting covers with fiberglass insert. Seal all fittings at end and throat.

9. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

10. Cold Condensate Drain Piping:

1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

11. Chilled Water Pump Bodies:

a. Chilled water pump bodies shall be insulated with 1 inch thick flexible expanded elastomeric insulation, install to allow for maintenance access to pump.

6. Refrigerant Suction and Liquid Piping: Thicknesses per Refrigerant Piping System of Section 230700 - 3.2, A.

   Fiberglass pipe covering with all service jacket self-seal lap. At Contractor's Option, a closed cell insulation with all joints butted and cemented may be used in lieu of fiberglass. Armaflex 22 or equal. If closed cell insulation is exposed to sunlight, coat all surfaces with UV protection to prevent long term deterioration from sunlight.

7. Refrigerant Hot Gas Piping:

   1" thickness fiberglass pipe covering with all service jacket self-seal lap, or 3/4" thick closed cell insulation. This is for safety purposes only, not for thermal efficiency.

8. Chilled Water Pump Bodies:

   b. Chilled water pump bodies shall be insulated with 1-inch thick flexible expanded elastomeric insulation, install to allow for maintenance access to pump.
   c. Apply a minimum coating thickness of 1/32” over all cold surfaces of the pump(s) with an anti-condensation coating to prevent sweating and dripping. Acceptable products: AQUABAN (chemicoat.com), or approved equal.

E. Buried Piping:

1. Do not disturb the bottom of trench, or compact and stabilize it to ensure proper support.
2. Remove any standing water in the bottom of trench.
3. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.
4. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.
5. Place insulation and backfill after field quality-control testing has been completed and results approved.
6. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors.
7. Wrap piping at bends, expansion loops, and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.
8. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.
9. Remove temporary hangers and supports.
10. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils (0.10 mm) thick, and empty loose-fill insulation bags on top.
11. Manually backfill 6 inches (150 mm) of clean backfill. If mechanical compaction is required, manually backfill to 12 inches (300 mm) before using mechanical-compaction equipment.

F. Refrigerant System:

1. Expanded polystyrene pipe covering with all service jacket and self-seal lap.
2. Refrigerant piping and brine piping: Insulate with thickness per Section 230700-3.2, A. Thickness over 2-1/2 inch may be applied in two layers. Ends of inner layer sections shall be staggered and taped. End and longitudinal joints of outer layer shall be staggered with inner layer joints. Secure with 1-inch fiberglass filament tape 12 inches on center. Provide factory applied all service jacket on outer layer. Seal all ends of insulation runs.
3. Valves and Fittings: Pre-molded covers fabricated of same material and thickness as pipe insulation. Fill gaps with injected foam insulation. Secure covers with 1 inch fiberglass filament tape.
4. Vessels: Insulate with two layers of prefabricated curved segments to fit vessel. Stagger all joints. Secure with banding 18 inches on center. Extend side insulation past tank head to thickness of insulation, insert circular end insulation. Fill voids with injected foam insulation.
5. Brine pumps: Pumps shall be insulated with 2-inch total thickness of flexible expanded elastomeric insulation, install to allow for maintenance access to pump.

G. Air Distribution System:

1. Exterior surfaces of outside air, combustion air, mixed air, and recovery coil discharge:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

2. Exterior surfaces of supply and return air plenums where not indicated to be lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins.

3. Exterior surfaces of exposed supply ductwork not lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

4. Concealed supply ductwork not lined:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

5. Low pressure round runouts to diffusers:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

6. See Specification Section 230540 – Mechanical Sound and Vibration Control for requirements for lined ductwork.

H. Other Systems:

1. Piping Insulation Exposed to Rainfall:

Provide 0.016-inch thick corrugated aluminum jacket and fitting covers on all insulation exposed to rainfall. Install seam on bottom of horizontal and angled piping. Seal all joints weather-tight. Seal jacket seams with silicone sealant.

2. Protective Insulation Jacketing:

   Provide high impact colored (Verify Color with Weber State University Facilities before any installation begins) polyvinyl chloride pipe covering on insulated piping that is exposed in mechanical rooms. Thickness to be 30 mil. Install where noted on drawings and per manufacturer's recommendations for hot and cold piping systems. Seal using solvent welding adhesive, providing slip joints as required for expansion and contraction. Ceel-Co Ceel-Tite 300 series, Schuller Zeston 300 series, or approved equal.

3. Condensate Drains Inside Buildings:

   1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

**END OF SECTION**

# SECTION 01 9126

# BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES:

A. The work under this section is subject to requirements of the Contract Documents, including the Owner's General Conditions and articles of the General Contractor's General Conditions.

B. This section includes the commissioning requirements for the Building Enclosure systems. Refer to Section 019119 for Building Enclosure Functional Performance Testing.

1. The commissioning requirements for the Building Enclosure systems given in this section are entirely separate from, and in addition to, the General Commissioning Requirements for this project. The General Contractor (GC), Contractors, Subcontractors, and Suppliers are required to participate in both commissioning processes as required any supplemental General Commissioning requirements.

2. The Commissioning Agent and Building Enclosure Commissioning Agent will provide separate documentation for each commissioning process.

### 1.2 DESCRIPTION

A. Building Enclosure Commissioning (BECx) is a systematic process of ensuring all building enclosure systems responsible for environment separation perform interactively according to the Owner's Project Requirements and the Architect's Basis of Design. The BECx process is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify and document proper installation and performance of building enclosure materials and systems.

2. Provide Owner with functional building enclosure systems with minimal performance problems at project completion.

B. Commissioning does not take away from, or reduce responsibility of, system designers or installing contractors to provide a finished and fully functioning product.

C. This section shall in no way diminish the responsibility of Division 03, 04, 07, 08, and 09 Contractors, Subcontractors, and Suppliers in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this section are in addition to requirements outlined in Division 03, 04, 07, 08, and 09.

### 1.3 ABBREVIATIONS

A. The following are common abbreviations used in the Specifications (definitions are found further in this Section):

1. A/E - Architect and Design Engineers
2. BECA – Building Enclosure Commissioning Agent
3. CxA - Commissioning Agent - Refer to Section 019113
4. GC - General Contractor
5. CT - Commissioning Team

6. Cx - Commissioning
7. Cx Plan - Commissioning Plan
8. FPT - Functional Performance Test
9. OR - Owner's Representative
10. O&M - Operations & Maintenance
11. RFI - Request for Information

## 1.4 DEFINITIONS

A. **Approval:** Acceptance that a material or system has been properly installed and is functioning in tested modes according to the Contract Documents.

B. **Architect/Engineer (A/E):** Prime consultant (architect) and sub-consultants who comprise the design team, generally the Architect of Record and any Design Sub-consultants.

C. **Basis of Design (BOD):** Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to meet intent.

D. **Building Enclosure Commissioning Agent (BECA):** Contracted to Owner through the CxA. BECA directs and coordinates day-to-day building enclosure commissioning activities independently from CxA.

E. **Commissioning Agent (CxA):** Contracted to Owner. CxA directs and coordinates day-to-day commissioning activities excluding BECx activities. CxA reports directly to Owner.

F. **Commissioning Plan:** Overall plan developed after bidding that provides structure, schedule, and coordination planning for commissioning process. A specific building enclosure section will be added into the project's commissioning plan.

G. **Contract Documents:** Documents binding on parties involved in construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).

H. **Deficiency:** Condition of a building enclosure material or system that is not in compliance with Contract Documents (that is, does not perform properly or is not complying with design intent).

I. **Functional Performance Test (FPT):** Test of performance of building enclosure materials and systems. Systems are tested under various simulated environmental conditions, such as air leakage under pressure differential and water leakage under pressure differential with water spray.

J. **Owner's Project Requirements (OPR):** A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

K. **Simulated Condition:** Condition created for testing component or system (e.g., applying pressure differential across the building enclosure concurrent with water spray to simulate a wind driven rain).

L. **Specifications:** Construction specifications of Contract Documents.

M. **Mock--up:** The activities where systems or materials are initially constructed and tested. Mock-ups are to be free standing and approved prior to commencing full scale construction.

N. **Sub-contractor:** Contractors of GC, and their Sub-contractors, who provide and install building enclosure components and systems.

## 1.5 RELATED WORK

A. Specific building enclosure commissioning requirements are given in this specification. The following specification sections are related to the commissioning work specified in this section:

1. General Commissioning Requirements: Refer to 019113
2. Building Enclosure Functional Performance Testing: Refer to 019119
3. Basic Concrete Requirements: Refer to Division 03
4. Basic Masonry Requirements: Refer to Division 04
5. Basic Waterproofing, Roofing, Air Barrier and Insulation Requirements: Refer to Division 07
6. Basic Fenestrations Requirements: Refer to Division 08
7. Basic Finishing Requirements: Refer to Division 09

## 1.6 COORDINATION

A. **Commissioning Team:** Members of the Commissioning Team (CT) will consist of:

1. Commissioning Agent (CxA)
2. Building Enclosure Commissioning Agent (BECA)
3. Building Enclosure Testing Agent (BETA)
4. Owner's Representative(s) (OR)
5. General Contractor (GC)
6. Architect and Design Engineers (A/E)
7. Building Enclosure Subcontractors

B. **Management:** Owner will contract services of the BECA directly. The BECA will direct and coordinate commissioning activities and report to the OR. All members of the Commissioning Team shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.

**C. Scheduling:**

1. BECA will work with commissioning team to establish required commissioning activities to incorporate in preliminary commissioning schedule. The GC will integrate commissioning activities into master construction schedule. Necessary notifications are to be made in a timely manner in order to expedite commissioning.

## 1.7 SUBMITTALS

A. A/E or General Contractor shall provide BECA with documentation required for commissioning work. At minimum, documentation shall include: General Commissioning Requirements and performance data and any performance test procedures. In addition, installation and checkout materials shall be submitted to BECA.

B. BECA shall review submittals concurrent with the A/E for conformance as it relates to commissioning.

## PART 2 – PRODUCTS (Not Used)

## PART 3 – EXECUTION

### 3.1 SYSTEMS TO BE COMMISSIONED

A. **Building Enclosure**

1. Below Grade Systems, Roofing Systems, Opaque Wall/Cladding Systems, Fenestration Systems responsible for providing the following functions:

    a. Air barrier
    b. Vapor barrier
    c. Insulation
    d. Waterproofing

### 3.2 RESPONSIBILITIES OF COMMISSIONING TEAM MEMBERS DURING CONSTRUCTION PHASE

A. **Architect/Engineer (A/E)**

1. Document design intent of systems.
2. Review and incorporate building enclosure commissioning specification and functional performance test specification into the construction documents.
3. Provide construction documents electronically.
4. Review BECA comments on construction document and shop drawings.
5. Assist in dispute resolution regarding building enclosure items.
6. Review BECA reports.

B. **Building Enclosure Commissioning Agent (BECA)**

1. Participate in an initial team conference call to identify the OPR
2. Develop BECx plan
3. Develop BECx Requirements specification
4. Develop Building Envelope Functional Performance Test specification
5. Review architectural drawings and specifications pertinent to the building envelope
6. Review shop drawings and submittals prior to or concurrent with the A/E reviews
7. Observe the construction of the mock-up and perform testing on the mock-up
8. Attend the construction BECx kick-off meeting
9. Finalize the commissioning plan
10. Field monitor installation of exterior envelope components against construction documents and manufacturer's instructions. Includes site visits to observe the testing of building enclosure components and assemblies.
11. Building envelope mock-up and field testing
12. Finalize commissioning records and close-out documents

C. **General Contractor (GC)**

1. Attend commissioning kick-off meeting and other commissioning team meetings.
2. Incorporate commissioning activities into the construction schedule.
3. Periodically update commissioning activities in the construction schedule.
4. Facilitate cooperation of Sub-contractors in commissioning work.
5. Submit copies of initial and final A/E approved submittals for commissioned system equipment to BECA for review.
6. Review BECA submittal comments
7. Verify building enclosure materials and assemblies are ready for functional testing.
8. Submit maintenance logs of all interim maintenance or repair tasks performed by Sub-contractors.
9. Insure resolution of non-compliance and deficiencies in construction or test results. Obtain written documentation of completion from the appropriate Sub-contractors.

10. Provide letters of compatibility for adjacent building enclosure materials and assemblies.
11. Facilitate all repairs and retesting of failed condition and pay for all associated costs.
12. Provide all warrantee information to BECA

D. **Subcontractors/Vendors**

1. Review Commissioning Plan and FPT specification.
2. Attend commissioning kick-off meeting and other commissioning team meetings.
3. Notify GC and BECA of work completion.
4. Attend all required material and systems testing.
5. Execute all periodic maintenance or repairs required on started systems from initial mock-up of equipment to final acceptance by Owner to prevent material warranties from being voided.
6. Ensure installation work is complete, is in compliance with Contract Documents, and is ready for Functional Performance Testing. Notify GC that equipment and systems are ready for Functional Performance Testing. FPT test results will be documented by BECA
7. Provide all warrantee information to GC.

E. **Building Enclosure Testing Agency (BETA)**

1. Attend commissioning kick-off meeting and other commissioning team meetings.
2. Provide on-site technician and equipment to complete mock-up and field Functional Performance Testing.
3. Prepare and submit reports at the conclusion of all testing.
4. Perform retesting and prepare corresponding reports.

## 3.3 BUILDING ENVELOP COMMISSIONING TEAM (BECx) MEETINGS

A. BECx meetings will be held periodically as determined by the BECA.

B. Discussions held in BECx meetings shall include, but not be limited to, system/materials, mock-up/field, progress, scheduling, testing, documentation, deficiencies, and problem resolution.

## 3.4 REPORTING

A. BECA will provide status reports to GC, CxA, A/E, and Owner as needed.

B. BECA shall submit non-compliance and deficiency reports to GC, CxA, A/E, and Owner as needed.

C. BECA shall provide a final summary report to CxA and Owner.

## 3.5 MOCK-UP AND FINAL CONSTRUCTION

A. GC and Subcontractors shall verify completion of assemblies compliant with project documents and deficiency log items prior to functional performance testing or concealment of functional performance layers within the building enclosure.

## 3.6 FUNCTIONAL PERFORMANCE TESTING

A. **Objectives and Scope**

1. The objective of Functional Performance Testing is to demonstrate each system is operating according to documented design intent and Contract Documents. Functional Performance Testing facilitates bringing systems from a state of substantial completion to fully operational. Additionally, during Functional Performance Testing, areas of deficient performance are identified and corrected, improving operation and functioning of systems.

B. **Development of Test Procedures**

1. The purpose of a specific test is to verify and document compliance of the installed enclosure systems with the OPR. The BECA shall develop specific test procedures for inclusion in Specification Section 019119 – Building Enclosure Functional Performance Testing

C. **Coordination and Scheduling**

1. GC will provide sufficient notice to BECA regarding completion schedule for materials and systems. GC will schedule Functional Performance Tests with CT. BECA shall witness and document functional testing of equipment and systems. BETA shall execute tests under direction of BECA. BETA may be the same entity as the BECA if deemed the best value to the project.

2. Successful completion of mock-up functional performance testing shall occur prior to full production installation of building enclosure materials and systems.

## 3.7 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. **Documentation**

1. BECA will witness and document results of FPT.

B. **Non-Conformance**

1. BECA will record results of functional testing. Deficiency or non-conformance issues will be noted and reported to GC, CxA and Owner.

2. Corrections of minor deficiencies identified may be made during tests at discretion of BECA. In such cases, deficiency and resolution will be documented.

3. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. BECA shall not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.

4. Deficiencies are handled in the following manner:

   a. When there is no dispute on deficiency and Sub-contractor accepts responsibility for remedial action:

      1) BECA documents deficiency and Sub-contractors response and intentions and they go on to another test or installation. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC. Sub-contractor corrects deficiency and certifies that material or assembly is ready to be retested. GC informs CT of retesting schedule.

      2) GC reschedules test with BECA and BETA.

   b. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

      1) BECA documents deficiency and Contractor's response. BECA submits deficiency report to GC, CxA and Owner. Copy is provided to Sub-contractor by GC.

      2) GC facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority is with A/E. Final acceptance authority is with the Owner.

      3) GC documents resolution process.

4) Once interpretation and resolution has been decided, appropriate party corrects deficiency, GC reschedules test, and test is repeated until satisfactory performance is achieved.

**C. Cost of Retesting**

1. Costs for all retesting will be the full responsibility of the GC and Subcontractors. These costs include all access, equipment, labor, and materials required to complete the retesting.

## 3.8 COMMISSIONING DOCUMENTATION

A. **Final Report Details**

1. Final commissioning report will include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, and general description of testing and verification methods. Report will contain evaluation regarding:

   a. Conformance to specifications and design intent
   b. Material/system installation
   c. Functional performance

2. All outstanding non-compliance items will be specifically listed.

3. Recommendations for improvement to system or operations, future actions, etc. will also be listed.

**END OF SECTION**

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## SECTION 23 0810

## VARIABLE FREQUENCY DRIVE

### PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. The contractor shall furnish and install a complete Variable Frequency Drive and Energy Efficient motor system on the following equipment as described in this specification and as indicated on the drawings.

1. Air Handler

B. The Variable Frequency Drive shall convert 480 volt (verify with equipment ordered), three phase, 60 Hz utility power to adjustable voltage and frequency, three phase, A-C power for stepless motor control from 6 to 60 Hz.

C. This contractor shall coordinate motor selection with Variable Frequency Drive.

D. Variable Frequency Drive Systems shall be compatible with any standard NEMA B or C design 3-phase induction motor. Variable Frequency Drive Systems shall be sized to insure the motor full load amps does not exceed the controller continuous RMS amps at project altitude (4500 ft.).

E. VFD shall be BACNET compliant and shall be interfaced to the BACNET network specified under Section 230900. The VFD shall be $N^2$ compatible or include integrator as required for complete integration into Owner's system and network interface shall conform to the BACNET Functional Profile for variable speed motor drives. All of the standard network variables listed in the functional profile shall be interfaced to the BACNET network.

### 1.2 QUALITY ASSURANCE

A. The equipment supplied under this specification shall conform to the latest applicable codes and standards of the following:

1. NEC – (NFPA 70) – National Electric Code.
2. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
3. NEMA AB1 – Molded Case Circuit Breakers.
4. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
5. IEEE Standard 519-1992 – Recommended Practices for Harmonic Control in Electrical Power Systems.
6. ANSI C37 – Standards for Circuit Breakers, Switchgear, Relays, Substations and Fuses.
7. ANSI C57 – Distribution, Power, and Regulating Transformers (includes Reactors).
8. UL 508C – Power Conversion Equipment.
9. NEMA ICS 3.1 – Safety Standards for Construction and Guide for Selection, Installation, and Operation of Variable Frequency Drive Systems.
10. FCC CFR 47 Part 15 subpart B.
11. State of Utah DFCM Standards.

B. The VFD's shall be UL listed for conformance to UL-508C. An equivalent safety labeling program by ETL or CSA documenting compliance with these industry standards will be acceptable.

C. The Division 23 Contractor shall coordinate and assume system responsibility and compatibility between the various approved suppliers' equipment and services required to meet these specifications.

D. The VFD system vendor shall provide a complete parts and labor warranty (including travel and shipping expenses) for one (1) year from the date of substantial completion. The warranty shall cover the entire VFD system including power devices, controllers, filters, communications interface, etc. furnished as part of the system package.

E. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application.

## 1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data in accordance with Section 230500 – Basic Mechanical Requirements.

1. VFD: Product data sheets, functional descriptions, performance ratings, dimensions, conduit entry/exit locations, installation instructions, complete wiring diagrams for power, controls, etc.
2. Control System Interface: Furnish complete documentation of the controls system interface including bus specification, object list, wiring diagrams, XIF or configuration files, etc.
3. Derate calculation for installation altitude above 3300 ft. and ambient temperature above 40°C.

B. Operating Instructions and Maintenance Data: Submit printed operating instructions and maintenance data in accordance with Section 230500 – Basic Mechanical Requirements.

1. VFD: Operating and Maintenance instructions, programming instructions, spare parts lists, troubleshooting instructions.
2. Factory test reports.
3. Start-up and commissioning reports.
4. Power quality test reports.

# PART 2 - PRODUCTS

## 2.1 APPROVED MANUFACTURERS

A. The following manufacturers are acceptable, submit alternates for prior approval in accordance with the General Conditions and Division 1 Requirements.

1. ABB
2. Yaskawa
3. Graham/Danfoss
4. Mitsubishi
5. Grudgos Inc.
6. Toshiba

## 2.2 CONSTRUCTION, VARIABLE FREQUENCY DRIVE

A. The Variable Frequency Inverter(s) shall be PWM type using IGBTs, rated for the motor type, horsepower, and voltage as indicated on drawings.

B. The Inverter shall be altitude compensated and sized for the elevation at which the unit will be installed. The inverter shall operate in an ambient temperature of –10°C to 50°C humidity of 0-90% non-condensing.

C. The VFD system manufacturer shall integrate all components and equipment required to meet these specification features and functions as a single UL (or equivalent) labeled system. Vendors providing equipment requiring panel shop or job site modifications or additions that would not be valid under the original equipment manufacturer's (OEM's) safety labeling will not be acceptable.

D. Pre-integrated equipment shall include but not be limited to incoming line filters, rectifier units, inverter units, control circuitry, operator interfaces, protective equipment, and other accessories and auxiliary items necessary to meet the highest standards for the type of service specified herein.

E. All VFD system components shall be housed in a grounded, dead front, free-standing or wall mounted, NEMA 1 enclosure. The VFD system size shall not exceed the size allotments specified on the drawings nor shall any portion of the system exceed a height of 90 inches. Entry shall be provided for incoming line and load cables as required or as shown on the drawings.

F. VFD systems mounted indoors shall be properly ventilated and sized to operate continuously at the job site elevation in an ambient environment of 0°C to 40°C, 0-90% RH. VFD systems mounted outdoors shall include environment control provisions as required (or as shown on the plans) to operate in an ambient of –30°C to 50°C, 0-100% RH.

G. All components of the VFD system shall be selected to operate continuously without any system trip or damage based on the nominal power specifications and requirements shown on the drawings or schedules. The above conditions must be maintained under the following expected variations:

1. Plus or minus 10% voltage fluctuation.
2. Plus or minus 3% frequency variation (5% if served by a back-up generator).
3. Distorted voltage waveform with up to 7% total voltage harmonic distortion.

H. The VFD system shall employ voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions:

1. 0% voltage for 1 cycle.
2. 60% voltage for 10 cycles.
3. 87% voltage continuous.

I. The VFD system shall employ door mounted industrial control operator devices, programming unit, and other devices as required to meet all functional and feature requirements of this specification. Operator pilot lights or LEDs, switches and pushbuttons (if required) shall be industrial oil tight industry standard devices.

J. Control voltages shall be 120 volts or less supplied by machine tool type transformers employing both primary and secondary fusing.

K. The VFD system factory wiring shall be permanently marked with hot emboss stamping or an equivalent marking system. All devices shall be labeled and identified with correct setting selections. All component identification and wiring shall be documented in the operation and maintenance manual.

L. The VFD system shall be capable of starting and continuously driving the specified maximum motor load as identified on the drawings and schedules.

M. VFD's driving variable torque loads shall be programmed to optimize load patterns which maximize system efficiency and minimize motor heating and stresses. VFD's driving constant torque or other loads shall be programmed to optimize load patterns for system or process performance as required.

N. All VFD systems shall have an overload capacity of a minimum of 120% for one minute.

O. The VFD solid state converter and inverter power switching components and control shall be selected to achieve a 0.95 efficiency or better at full load and speed. Other auxiliary devices required on the drawings or in these specifications including filters, line reactors, cooling or heating devices etc. shall be of a design to optimize efficiency as intended under this specification.

P. The entire true system power factor (as measured at the input to the VFD system) shall be 0.95 or better across the operational speed and load range. Power factor that becomes leading under light load conditions (due to PF correction) is acceptable only if voltage rise is prevented from backfeeding to the rest of the system (meaning PF correction must act like a synchronous condenser). The voltage tolerance at the main VFD system input terminals shall not be compromised as a result of power factor correction techniques.

Q. Short circuit protection shall be provided to the VFD system through an externally operated, door interlocked fused disconnect, circuit breaker or motor circuit protector (MCP). VFD shall have a minimum short circuit rating of 65,00 amps RMS (100,000 amps RMS with DC bus reactor) without additional input fusing. The door interlocked handle must be capable of being locked off to meet NEC.

R. Overcurrent protection shall be provided in the VFD system through electronic motor overload (MOL) circuits with instantaneous trip, inverse time trip, and current limit functions. These shall be adjustable and optimized for the application.

S. In addition to the overcurrent protection above, the VFD system shall provide over and under voltage protection, over temperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall remain in memory for future review.

T. The VFD system customer terminations shall be clearly identified with terminal numbers and a permanent wiring diagram located in the VFD system enclosure. Coordinate all control work with Section 230900 Contractor.

U. VFD shall meet the requirements for Radio Frequency Interference as specified by FCC Regulations, Part 15, Subpart J, Class A devices.

## 2.3 FEATURES, VARIABLE FREQUENCY DRIVES

A. The following operator control and indication features shall be provided standard (unless shown differently on the drawings) as part of each VFD system, all pilot lights to be L.E.D. type:

1. Hand-Off-Auto (local start at VFD, remote start with contact closure).
2. Local-Remote speed control (local speed control at VFD, remote speed control through speed reference signal).
3. Frequency (speed) indication.
4. Motor voltage indication.
5. Motor current indication.
6. VFD run indication.
7. VFD fault and diagnostic indication.

B. The following customer connections and interface terminations shall be provided standard (unless shown differently on the drawings) as part of each VFD system:

1. VFD remote start/stop connection.
2. External safeties connection.
3. VFD run annunciation.
4. VFD fault annunciation.
5. VFD speed reference input connection (4-20mA or as shown on drawings).
6. Minimum of three (3) programmable digital inputs.
7. Minimum of two (2) 4-20mA input signals to integral controller.

C. The following parameter adjustments shall be available to tune the VFD system:

1. Minimum and maximum speeds.
2. Acceleration and declaration times.
3. Overcurrent trip point.
4. Current limit response to overload.
5. Maximum base motor voltage.
6. Input speed reference signal gain and bias.
7. Output speed reference signal gain and bias.
8. Critical frequency avoidance.
9. Multiple preset speed programming.
10. Integral PI controller programming.

D. The VFD shall be capable of starting into a rotating motor at any speed and rotation direction.

E. The VFD shall auto restart after a power failure.

F. For maintenance purposes, the VFD system shall be capable of starting, stopping, and running with stable operation with the motor completely disconnected (no load).

G. VFD shall include an integral locking disconnect.

H. VFD shall include an integral PI controller capable of closed loop control of motor speed based on external analog speed reference signals or programmed digital input signals.

## 2.4 FACTORY TEST, VARIABLE FREQUENCY DRIVE

A. Prior to shipping any equipment, the manufacturer shall individually test and certify each unit to document compliance. This certification report shall be submitted as part of the operation and maintenance manual and include the following minimum testing:

1. A visual inspection shall be made consisting of all system components, wiring connections, and safety mechanisms.
2. High pot testing shall be conducted on the completed VFD system including all accessory power components as a complete package. This test shall be conducted per UL 508C (two times the rated voltage plus 1000 volts AC for 60 seconds) using regularly calibrated high pot test equipment.
3. A system run test shall be conducted using an actual motor accelerated and decelerated through the entire speed range.
4. All control panel devices, including switches, pilot lamps, keypad and special control devices shall be functional tested.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Field start-up service shall be provided by an authorized factory representative. The supplier shall provide warranty and authorized factory services including field start-up and training. The following adjustments and tests shall be performed as a minimum with certified copies included in the operation and maintenance manual:

1. Verify that the input voltage is within the manufacturer's specification tolerances.
2. Verify that the motor rotation is correct in all modes of operation.
3. Verify all operator devices, programming, and monitoring functions to be fully operational.
5. Verify operation of all field signal control connections.
6. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate rating at full speed. Check full load current measurements against nameplate data.
7. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
8. Conduct harmonic tests as identified in this specification. Measurements shall be recorded for each unit with the VFD system off, running at 50% speed, and running at full speed and load.

B. Owner training shall be provided for each model and type of VFD system provided. Training shall consist of both classroom and actual equipment hands-on training.

C. Installation shall be in accordance with manufacturer's printed instructions.

D. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application. If no location is feasible to meet this location criteria, the VFD may be mounted inside a NEMA 3R enclosure in the dirty air location.

## 3.2 SPARE PARTS

A. Furnish one spare main logic board, key pad, and power supply board. Furnish one set of spare parts for each unique VFD design supplied.

**END OF SECTION**

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# SECTION 23 0900

# ELECTRONIC CONTROLS

## PART 1 – GENERAL

### 1.1 TABLE OF RELATED DOCUMENTS

A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.

B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

### 1.2 DEFINITIONS

A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.

C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.

D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.

E. Control Sequence: An BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.

F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

H. Node: A digitally programmable entity existing on the BMS network.

I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.

J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

K. PC: IBM-compatible Personal Computer from a recognized major manufacturer

L. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BMS Contractor’s cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.

M. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.

N. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

O. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.

P. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.

Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

S. The following abbreviations and acronyms may be used in describing the work of this Division:

| | | |
|---|---|---|
| ADC | - | Analog to Digital Converter |
| AI | - | Analog Input |
| AN | - | Application Node |
| ANSI | - | American National Standards Institute |
| AO | - | Analog Output |
| ASCII | - | American Standard Code for Information Interchange |
| ASHRAE | | American Society of Heating, Refrigeration and Air Conditioning Engineers |
| AWG | - | American Wire Gauge |
| CPU | - | Central Processing Unit |
| CRT | - | Cathode Ray Tube |

| | | |
|---|---|---|
| DAC | - | Digital to Analog Converter |
| DDC | - | Direct Digital Control |
| DI | - | Digital Input |
| DO | - | Digital Output |
| EEPROM | - | Electronically Erasable Programmable Read Only Memory |
| EMI | - | Electromagnetic Interference |
| FAS | - | Fire Alarm Detection and Annunciation System |
| GUI | - | Graphical User Interface |
| HOA | - | Hand-Off-Auto |
| ID | - | Identification |
| IEEE | - | Institute of Electrical and Electronics Engineers |
| I/O | - | Input/Output |
| LAN | - | Local Area Network |
| LCD | - | Liquid Crystal Display |
| LED | - | Light Emitting Diode |
| MCC | - | Motor Control Center |
| NC | - | Normally Closed |
| NIC | - | Not In Contract |
| NO | - | Normally Open |
| OWS | - | Operator Workstation |
| OAT | - | Outdoor Air Temperature |
| PC | - | Personal Computer |
| RAM | - | Random Access Memory |
| RF | - | Radio Frequency |
| RFI | - | Radio Frequency Interference |
| RH | - | Relative Humidity |
| ROM | - | Read Only Memory |
| RTD | - | Resistance Temperature Device |
| SPDT | - | Single Pole Double Throw |
| SPST | - | Single Pole Single Throw |
| XVGA | - | Extended Video Graphics Adapter |
| TBA | - | To Be Advised |
| TCP/IP | - | Transmission Control Protocol/Internet Protocol |
| TTD | - | Thermistor Temperature Device |
| UPS | - | Uninterruptible Power Supply |
| VAC | - | Volts, Alternating Current |
| VAV | - | Variable Air Volume |
| VDC | - | Volts, Direct Current |
| WAN | - | Wide Area Network |

## 1.3 BMS DESCRIPTION

A. The Building Management System shall be integrated into the existing campus control system (Johnson Metasys) through the Stromberg Gym System. Use JCI Metasys Extended Architecture (i.e. using BACnet MS/TP communications with NAE/NCE DDC routers/panels) no substitutions allowed. Include all required graphics. Controls interface to integrate new controls into existing Stromberg controls. Upgrade of existing controls serving the (4) existing air handlers in the main gym area to the new standard in the addition.

B. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the FMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

C. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

D. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

E. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS. All BAS acceptance testing shall be performed in the presence of the Owner or Owner designated representative. The system shall not be considered substantially complete until the testing is complete and approved. The contractor shall perform all calibration, start-up, and testing procedures necessary to assure the completion of the system acceptance testing prior to commencement of the system acceptance test. The contractor to schedule any acceptance tests with the WSU Project Manager at least 72 hours in advance.

F. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

G. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

H. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.
8. Indoor Air Quality monitoring and control Co2 sensors and airflow meters.
9. DDC routers/panels to connect to the building/campus BAS via Ethernet/IP.

## 1.4 QUALITY ASSURANCE

A. General:

1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
2. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
3. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
5. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

B. Workplace Safety And Hazardous Materials:

1. Provide a safety program in compliance with the Contract Documents.
2. The FMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:

   a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   b. Manage the financial aspects of the BMS Contract.
   c. Coordinate as necessary with other trades.
   d. Be responsible for the work and actions of the BMS workforce on site.

## 1.5 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
9. NFPA 92A and 92B Smoke Purge/Control Equipment.
10. Factory Mutual (FM).
11. American National Standards Institute (ANSI).
12. National Electric Manufacturer’s Association (NEMA).
13. American Society of Mechanical Engineers (ASME).
14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) [user note: add ASHRAE 62 IAQ as applicable].
15. Air Movement and Control Association (AMCA).
16. Institute of Electrical and Electronic Engineers (IEEE).
17. American Standard Code for Information Interchange (ASCII).
18. Electronics Industries Association (EIA).
19. Occupational Safety and Health Administration (OSHA).
20. American Society for Testing and Materials (ASTM).
21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
22. Americans Disability Act (ADA)
23. ANSI/EIA 909.1-A-1999 (BACNET)
24 ANSI/ASHRAE Standard 195-2004 (BACnet)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

## 1.6 WORK BY OTHERS

A. The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the BMS RESPONSIBILITY MATRIX

| BMS RESPONSIBILITY MATRIX | | | | |
|---|---|---|---|---|
| **WORK** | **FURNISH** | **INSTALL** | **Low Volt. WIRING/TUBE** | **LINE POWER** |
| BMS low voltage and communication wiring | BMS | BMS | BMS | N/A |
| BMS conduits and raceway | BMS | BMS | BMS | BMS |
| Automatic dampers | BMS | 23 | N/A | N/A |
| Manual valves | 23 | 23 | N/A | N/A |
| Automatic valves | BMS | 23 | BMS | N/A |
| Pipe insertion devices and taps including thermowells, flow and pressure stations. | BMS | 23 | BMS | BMS |
| BMS Current Switches. | BMS | BMS | BMS | N/A |
| BMS Control Relays | BMS | BMS | BMS | N/A |
| Power distribution system monitoring interfaces | 26 | 26 | BMS | 26 |
| Water Source Heat Pumps | 23 | 23 | 23 | 23 |
| All BMS Nodes, equipment, housings, enclosures and panels. | BMS | BMS | BMS | BMS |
| Smoke Detectors | 26 | 26 | 26 | 26 |
| Fire/Smoke Dampers | 23 | 23 | BMS | 26 |
| Fire Dampers | 23 | 23 | N/A | N/A |
| Boiler wiring | 23 | 23 | 23 | 23 |
| Water treatment system | 23 | 23 | 23 | 26 |
| VFDs | 23 | 26 | BMS | 26 |
| Fire Alarm shutdown relay interlock wiring | 26 | 26 | 26 | 26 |
| Fire Alarm smoke control relay interlock wiring | 26 | 26 | BMS | 26 |
| Fireman's Smoke Control Override Panel | 26 | 26 | 26 | 26 |
| Starters, HOA switches | 26 | 26 | N/A | 26 |
| Control damper actuators | BMS | BMS | BMS | 26 |

*The Central Plant BMS will furnish the BacNet interface, but the Campus BMS will communicate and monitor the Plant BMS

## 1.7 SUBMITTALS

A. Shop Drawings, Product Data, and Samples:

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.

4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:

    a. BMS network architecture diagrams including all nodes and interconnections.
    b. Systems schematics, sequences and flow diagrams.
    c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
    d. Samples of Graphic Display screen types and associated menus.
    e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
    f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
    g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
    h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
    i. Details of all BMS interfaces and connections to the work of other trades.
    j. Alarm routing.
    k. DDC device and network numbering.
    l. BDT tables for BBMD.
    m. Trend logs.
    n. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

## 1.8 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals:

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:

    a. Table of contents.
    b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
    c. Manufacturers product data sheets or catalog pages for all products including software.

d. System Operator's manuals.
e. Archive copy of all site-specific databases and sequences.
f. BMS network diagrams.
g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

## 1.9 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

# PART 2 – PRODUCTS

## 2.1 LARGE GENERAL DESCRIPTION

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Engine(s)
2. Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Portable Operator's Terminal(s)
6. Distributed User Interface(s)
7. Network processing, data storage and communications equipment
8. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

## 2.2 BMS ARCHITECTURE

A. Automation Network:

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Engines shall reside on the automation network.
4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

B. Control Network:

1. Network Supervisor shall provide supervisory control over the control network and shall support the following communication protocol:

    a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.

2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. The Conformance Statements shall be submitted 10 day prior to bidding.

C. Integration:

1. BACnet Protocol Integration – BACnet

    a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
    b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
    c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

## 2.3 USER INTERFACE

A. Distributed Web Based User Interface:

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser.
3. Minimum hardware requirements:

    1) 256 MB RAM
    2) 2.0 GHz Clock Speed Pentium 4 Microprocessor.
    3) 40.0 GB Hard Drive.
    4) 1 Keyboard with 83 keys (minimum).
    5) SVGA 1024x768 resolution display with 64K colors and 16 bit color depth.
    6) Mouse or other pointing device

B. User Interface Application Components:

1. Operator Interface

    a. An integrated browser based client application shall be used as the user operator interface program.
    b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
    c. The user interface software shall provide help menus and instructions for each operation and/or application.
    d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
    e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

        1) User access for selective information retrieval and control command execution
        2) Monitoring and reporting
        3) Alarm, non-normal, and return to normal condition annunciation
        4) Selective operator override and other control actions
        5) Information archiving, manipulation, formatting, display and reporting
        6) FMS internal performance supervision and diagnostics
        7) On-line access to user HELP menus
        8) On-line access to current FMS as-built records and documentation
        9) Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.

f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees

a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.

b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.

c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms

a. Alarms shall be routed directly from Network Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

1) Log date and time of alarm occurrence.
2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
6) Any attribute of any object in the system may be designated to report an alarm.

b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

c. The FMS shall annunciate application alarms at minimum, as required by Part 3.

4. Reports and Summaries

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

1) All points in the BMS
2) All points in each BMS application
3) All points in a specific controller
4) All points in a user-defined group of points
5) All points currently in alarm
6) All points locked out
7) All BMS schedules
8) All user defined and adjustable variables, schedules, interlocks and the like.

b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

1) Weekly schedules
2) Exception Schedules
3) Monthly calendars.

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
e. Changes to schedules made from the User Interface shall directly modify the Network Engine schedule database.
f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password

   a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
   b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
   c. The system shall allow each user to change his or her password at will.
   d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
   e. A minimum of five levels of access shall be supported individually or in any combination as follows:

      1) Level 1 = View Data
      2) Level 2 = Command
      3) Level 3 = Operator Overrides
      4) Level 4 = Database Modification
      5) Level 5 = Database Configuration
      6) Level 6 = All privileges, including Password Add/Modify

   f. A minimum of 100 unique passwords shall be supported.
   g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
   h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.

8. Dynamic Color Graphics

   a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable. All new graphics to match existing WSU controls graphics.
   b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
      The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
   c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:

      1) All graphics shall be fully scalable
      2) The graphics shall support a maintained aspect ratio.

3) Multiple fonts shall be supported.
4) Unique background shall be assignable on a per graphic basis.
5) The color of all animations and values on displays shall indicate if the status of the object attribute.

d. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device

e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

1) The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
2) In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

a. The Building Management System shall store trend and point history data for all analog and digital inputs and outputs, as follows:

1) Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
Defined time interval
Upon a change of value
2) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

10. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.
b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

## 2.4 NETWORK ENGINES/SUPERVISOR

A. Network Engine/Servers

1. The Network Engine shall be a fully user-programmable, supervisory controller. The Network Engine shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Engines.
2. Automation network – The Network Supervisor shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each Network Supervisor shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

    a. The web based UI software shall be imbedded in the Network Supervisor. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
    b. The Network Supervisor shall support up a minimum of four (4) concurrent users.
    c. The web based user shall have the capability to access all system data through one Network Supervisor.
    d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one Network Supervisor.
    e. Systems that require the user to address more than one Network Supervisor to access all system information are not acceptable.
    f. The Network Supervisor shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the Network Supervisor.
    g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
    h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

        1) Configuration
        2) Commissioning
        3) Data Archiving
        4) Monitoring
        5) Commanding
        6) System Diagnostics

    i. Systems that require workstation software or modified web browsers are not acceptable.
    j. The Network Supervisor shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The Network Supervisor shall be microprocessor-based with a minimum word size of 32 bits. The Network Supervisor shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Network Supervisor size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory – Each Network Supervisor shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The Network Supervisor shall include an integrated, hardware-based, real-time clock.
7. The Network Supervisor shall include troubleshooting LED indicators to identify the following conditions:

    a. Power - On/Off
    b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
    c. Ethernet Connection Speed – 10 Mbps/100 Mbps
    d. FC Bus A – Normal Communications/No Field Communications
    e. FC Bus B – Normal Communications/No Field Communications
    f. Peer Communication – Data Traffic Between Network Supervisor Devices
    g. Run – Network Supervisor Running/ Network Supervisor In Startup/ Network Supervisor Shutting Down/Software Not Running
    h. Bat Fault – Battery Defective, Data Protection Battery Not Installed
    i. 24 VAC – 24 VAC Present/Loss Of 24VAC
    j. Fault – General Fault
    k. Modem RX – Network Supervisor Modem Receiving Data
    l. Modem TX – Network Supervisor Modem Transmitting Data

8. Communications Ports – The Network Supervisor shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

    a. Two (2) USB port
    b. Two (2) URS-232 serial data communication port
    c. Two (2) RS-485 port
    d. One (1) Ethernet port

9. Diagnostics – The Network Supervisor shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Supervisor shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The Network Supervisor shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The Network Supervisor shall be listed by Underwriters Laboratories (UL).

12. Controller network – The Network Supervisor shall support the following communication protocols on the controller network:

    a. The Network Supervisor shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

        1) A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
        2) The Conformance Statements shall be submitted 10 day prior to bidding.
        3) The Network Supervisor shall support a minimum of 100 control devices.

    b. The Network Supervisor shall support BACNET enabled devices using the Free Topology Transceiver FTT10.

        1) All BACNET controls devices shall be BACNET certified.
        2) The Network Supervisor shall support a minimum of 255 BACNET enabled control devices.

    c. The Building Management System shall be able to integrate the Johnson Controls N2 Field Bus.

        1) The Network Supervisor shall support a minimum of 100 N2 control devices.
        2) The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
        3) The Bus shall employ a master/slave protocol where the Network Supervisor is the master.
        4) The Bus shall employ a four (4) level priority system for polling frequency.
        5) The Bus shall be optically isolated from the Network Supervisor.

## 2.5 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller:

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The FEC shall include a removable base to allow pre-wiring without the controller.
5. The FEC shall include troubleshooting LED indicators to identify the following conditions:

    a. Power On
    b. Power Off
    c. Download or Startup in progress, not ready for normal operation
    d. No Faults

e. Device Fault
f. Field Controller Bus - Normal Data Transmission
g. Field Controller Bus - No Data Transmission
h. Field Controller Bus - No Communication
i. Sensor-Actuator Bus - Normal Data Transmission
j. Sensor-Actuator Bus - No Data Transmission
k. Sensor-Actuator Bus - No Communication

6. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
7. The FEC shall support the following types of inputs and outputs:

a. Universal Inputs - shall be configured to monitor any of the following:

1) Analog Input, Voltage Mode
2) Analog Input, Current Mode
3) Analog Input, Resistive Mode
4) Binary Input, Dry Contact Maintained Mode
5) Binary Input, Pulse Counter Mode

b. Binary Inputs - shall be configured to monitor either of the following:

1) Dry Contact Maintained Mode
2) Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following

1) Analog Output, Voltage Mode
2) Analog Output, current Mode

d. Binary Outputs - shall output the following:

1) 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:

1) Analog Output, Voltage Mode
2) Binary Output Mode

8. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
b. The FC Bus shall support communications between the FECs and the Network Supervisor.
c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the Network Supervisor.
d. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

9. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

   a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
   b. The SA Bus shall support a minimum of 10 devices per trunk.
   c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

10. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
11. The FEC shall support, but not be limited to, the following:

   a. Hot water, chilled water/central plant applications
   b. Built-up air handling units for special applications
   c. Terminal units
   d. Special programs as required for systems control

## 2.6 FIELD DEVICES

A. Input/Output Module:

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
2. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The IOM shall have a minimum of 4 points to a maximum of 17 points.
5. The IOM shall support the following types of inputs and outputs:

   a. Universal Inputs - shall be configured to monitor any of the following:

      1) Analog Input, Voltage Mode
      2) Analog Input, Current Mode
      3) Analog Input, Resistive Mode
      4) Binary Input, Dry Contact Maintained Mode
      5) Binary Input, Pulse Counter Mode

   b. Binary Inputs - shall be configured to monitor either of the following:

      1) Dry Contact Maintained Mode
      2) Pulse Counter Mode

   c. Analog Outputs - shall be configured to output either of the following

      1) Analog Output, Voltage Mode
      2) Analog Output, current Mode

   d. Binary Outputs - shall output the following:

      1) 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:

1) Analog Output, Voltage Mode
2) Binary Output Mode

6. The IOM shall include troubleshooting LED indicators to identify the following conditions:

a. Power On
b. Power Off
c. Download or Startup in progress, not ready for normal operation
d. No Faults
e. Device Fault
f. Normal Data Transmission
g. No Data Transmission
h. No Communication

B. Networked Thermostat:

1. The Networked Thermostat shall be capable of controlling a heat pump system with single-speed fan control.
2. The Networked Thermostat shall communicate over the Field Controller Bus using BACnet Standard protocol SSPC-135, Clause 9.

a. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Engine.

3. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.

a. Two line, 8 character backlit display
b. LED indicators for Fan, Heat, and Cool status
c. Five (5) User Interface Keys

1) Mode
2) Fan
3) Override
4) Degrees C/F
5) Up/Down

d. The display shall continuously scroll through the following parameters:

1) Room Temperature
2) System Mode
3) Schedule Status – Occupied/Unoccupied/Override
4) Applicable Alarms

4. The Networked Thermostat shall provide the flexibility to support any one of the following inputs:

a. Integral Indoor Air Temperature Sensor
b. Duct Mount Air Temperature Sensor
c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
d. Two configurable binary inputs

5. The Networked Thermostat shall provide the flexibility to support any one of the following outputs:

    a. Three Speed Fan Control
    b. Two On/Off
    c. Two Floating
    d. Two Proportional (0 to 10V)

6. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
7. The Networked Thermostat shall provide the flexibility to adjust the following parameters:

    a. Adjustable Temporary Occupancy from 0 to 24 hours
    b. Adjustable heating/cooling deadband from 2º F to 5º F
    c. Adjustable heating/cooling cycles per hour from 4 to 8

8. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

C. Network Sensors

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

    a. Zone Temperature
    b. Zone humidity
    c. Zone setpoint

2. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
3. The Network Sensors shall include the following items:

    a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
    b. An LED to indicate the status of the Override feature.
    c. A button to toggle the temperature display between Fahrenheit and Celsius.
    d. A button to initiate a timed override command

4. The NS shall be available with either screw terminals or phone jack.
5. The NS shall be available in either surface mount or wall mount styles.

D. System Configuration Tool **(SCT)**

1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Engine.
2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
4. The configuration tool shall include the following features:

    a. Basic system navigation tree for connected networks

b. Integration of BACNET, and BACnet enabled devices
c. Customized user navigation trees
d. Point naming operating parameter setting
e. Graphic diagram configuration
f. Alarm and event message routing
g. Graphical logic connector tool for custom programming
h. Downloading, uploading, and archiving databases

5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:

a. BACnet Devices
b. BACNET devices

6. The configuration tool shall be capable of programming the Field Equipment Controllers.

a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
c. The configuration tool shall contain a library of standard applications to be used for configuration.

7. The configuration tool shall be capable of programming the field devices.

a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
c. The configuration tool shall contain a library of standard applications to be used for configuration

8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.

a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
c. The wireless connection shall use the Bluetooth Wireless Technology.

E. Wireless MS/TP Converter

a. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
b. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.
c. The converter shall employ Bluetooth Wireless Technology.
d. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
e. The converter shall operate over a minimum of thirty three (33) feet within a building.

f. The converter shall have LED indicators to provide information regarding the following conditions:

1) Power - On/Off
2) Fault – Fault/No Fault
3) SA/FC Bus – Bus Activity/ No Bus Activity
4) Blue – Bluetooth Communication Established/ Bluetooth Communication Not Established

g. The device shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.

## 2.7 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:

a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

| **Point Type** | **Accuracy** |
|---|---|
| Chilled Water | ± .5°F. |
| Room Temp | ± .5°F. |
| Duct Temperature | ± .5°F. |
| All Others | ± .75°F. |

2. Room Temperature Sensors

a. Room sensors shall be constructed for either surface or wall box mounting.
b. Room sensors shall have the following options when specified:

1) Setpoint reset slide switch providing a ±3 degree (adjustable) range.
2) Individual heating/cooling setpoint slide switches.
3) A momentary override request push button for activation of after-hours operation.
4) Analog thermometer.

3. Room Temperature Sensors with Integral Display

   a. Room sensors shall be constructed for either surface or wall box mounting.
   b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:

      1) Display room and outside air temperatures.
      2) Display and adjust room comfort setpoint.
      3) Display and adjust fan operation status.
      4) Timed override request push button with LED status for activation of after-hours operation.
      5) Display controller mode.
      6) Password selectable adjustment of setpoint and override modes.

4. Thermo wells

   a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
   b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
   c. Thermo wells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.
   d. Thermo wells shall be constructed of 316 stainless steel.

5. Outside Air Sensors

   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

6. Duct Mount Sensors

   a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
   b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

7. Averaging Sensors

   a. For air handler coils or ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used. Sensor length minimum 12”for each square foot of cut or coil.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

8. Acceptable Manufacturers: Johnson Controls, Setra, or approved equal.

C. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac, or approved equal.

D. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:

a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

2. Low Differential Water Pressure Applications (0” - 20” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) .01-20” w.c. input differential pressure range.
2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: Setra and Mamac, or approved equal.

3. Medium to High Differential Water Pressure Applications (Over 21” w.c.)

a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:

1) Differential pressure range 10” w.c. to 300 PSI.
2) Reference Accuracy: ±1% of full span (includes non-linearity, hysteresis, and repeatability).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable Manufacturers: Setra and Mamac, or approved equal.

4. Building Differential Air Pressure Applications (-0.1” w.c. to +0.1” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) -0.1” w.c. to +0.1” w.c. input differential pressure ranges. (Select range appropriate for system application)
2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: AutoTran #750D.

5. Low Differential Air Pressure Applications (0” to 5” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) (0.00 - 1.00” to 5.00”) w.c. input differential pressure ranges. (Select range appropriate for system application.)
2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: Johnson Controls and Setra, or approved equal.

6. Medium Differential Air Pressure Applications (5” to 21” w.c.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable manufacturers: Johnson Controls and Setra, or approved equal.

E. Flow Monitoring

1. Water Flow Monitoring

a. Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.

b. Acceptable manufacturers: Onicon, or approved equal.

F. Power Monitoring Devices

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

1) Operating frequency – 50 - 400 Hz.
2) Insulation – 0.6 Kv class 10Kv BIL.
3) UL recognized.
4) Five amp secondary.
5) Select current ration as appropriate for application.
6) Acceptable manufacturers: Veris Industries, or approved equal.

c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

1) 6X input over amp rating for AC inrushes of up to 120 amps.
2) Manufactured to UL 1244.

3) Accuracy: +.5%, Ripple +1%.
4) Minimum load resistance 30kOhm.
5) Input 0-20 Amps.
6) Output 4-20 mA.
7) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
8) Acceptable manufacturers: Veris Industries, or approved equal.

G. Refrigerant Leak Detectors

1. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.
2. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.
3. Acceptable manufacturers: Johnson Controls, MSA Instruments, or approved equal.

H. Smoke Detectors

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26, Fire Alarm System.

I. Status and Safety Switches

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
d. Acceptable manufacturers: Veris Industries, or approved equal.

3. Air Filter Status Switches

   a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
   c. Provide appropriate scale range and differential adjustment for intended service.
   d. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.

4. Air Flow Switches

   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
   b. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.

5. Air Pressure Safety Switches

   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
   c. Acceptable manufacturers: Johnson Controls, Cleveland Controls, or approved equal.

6. Water Flow Switches

   a. Water flow switches shall be equal to the Johnson Controls P74, or approved equal.

7. Low Temperature Limit Switches

   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
   d. The low temperature limit switch shall be equal to Johnson Controls A70, or approved equal.

## 2.8 OUTPUT DEVICES

A. Actuators

1. General Requirements

a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.

2. Electronic Damper Actuators

a. Electronic damper actuators shall be direct shaft mount.
b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
e. Acceptable manufacturers: Johnson Controls, Mamac, or approved equal.

3. Electronic Valve Actuators

a. Electronic valve actuators shall be manufactured by the valve manufacturer.
b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

f. Acceptable manufacturers: Johnson Controls, or approved equal.

B. Control Dampers

1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls D-7250 D-1250 or D-1300, Ruskin CD50, and Vent Products 5650, or approved equal.

6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800, or approved equal..
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120VAC.
e. Relays shall have an integral indicator light and check button.
f. Acceptable manufacturers: Johnson Controls, Lectro, or approved equal.

2. Lighting Control Relays

a. Lighting control relays shall be latching with integral status contacts.
b. Contacts shall be rated for 20 amps at 277 VAC.
c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
d. Lighting control relays shall be controlled by:

1) Pulsed Tri-state Output – Preferred method.
2) Pulsed Paired Binary Outputs.
3) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.

e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Control Valves

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Chilled water control valves shall be modulating plug, ball as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving **variable** flow air handling unit coils shall be sized for a pressure drop equal to between 3 to 5 PSI. Valves (3-way) serving **constant** flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop accounting for piping geometry. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop accounting for piping geometry. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Ball valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way ball valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. 3-way valves for modulating service shall be sized to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. Acceptable manufacturers: Johnson Controls, or approved equal.

E. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies, or approved equal.

F. External Manual Override Stations

1. External manual override stations shall provide the following:

   a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
   b. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
   c. A Status LED shall illuminate whenever the output is ON.
   d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
   e. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

## 2.9 MISCELLANEOUS DEVICES

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

C. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

# PART 3 – PERFORMANCE / EXECUTION

## 3.1 BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

B. Custom Reports:

1. Provide custom reports as required for this project:

## 3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring

    a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
    b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. All wiring not in conduit to be plenum rated.

5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2”.

2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
   Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – Genera1

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors

   a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

b. Sensors shall be installed with a rain proof, perforated cover.

6. Water Differential Pressure Sensors

a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
c. The transmitters shall be installed in an accessible location wherever possible.

7. Medium to High Differential Water Pressure Applications (Over 21” w.c.):

a. Air bleed units, bypass valves and compression fittings shall be provided.

8. Building Differential Air Pressure Applications (-1” to +1” w.c.):

a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
b. The interior tip shall be inconspicuous and located as shown on the drawings.

9. Duct Temperature Sensors:

a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
d. The sensor shall be mounted to suitable supports using factory approved element holders.

10. Space Sensors:

a. Shall be mounted per ADA requirements.
b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

11. Low Temperature Limit Switches:

a. Install on the discharge side of the first water or steam coil in the air stream.
b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

12. Air Differential Pressure Status Switches:

a. Install with static pressure tips, tubing, fittings, and air filter.

13. Water Differential Pressure Status Switches:

    a. Install with shut off valves for isolation.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs.
5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

## 3.3 TRAINING

A. The BMS contractor shall provide the following training services independent of training for any other separate building in project:

1. 16-hours of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.
2. 24 hours of classroom training for WSU personnel in a location provided by WSU. Training to be provided after the system has been installed, started, tested, commissioned, demonstrated and prior to final acceptance by the Engineer and Owner. Training to include overview of BAS architecture and products, Use of the operators manuals and shop drawings to understand and troubleshoot the system, Use of the operator interfaces, Logging on and off the BAS, Accessing point status reports, graphics and trend logs, Accessing and adjusting set points and schedules, Manual BAS overrides, Introduction to custom application programming.
3. 80-hours of off-site training at equipment factory. Contractor to include all Fees, airfare, travel costs, hotel costs, etc., no additional costs to Owner.

## 3.4 COMMISSIONING

A. Fully commission all aspects of the Building Management System work.

B. Acceptance Check Sheet

1. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.
2. Submit the check sheet to the Engineer for approval
3. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.

C. VAV box performance verification and documentation:

1. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
2. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.

D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

## 3.5 VFD CONTROL

A. VFD to be controllable and programmable/adjustable through the BMS system.

## 3.6 INTEGRATION OF THE FOLLOWING SYSTEMS INTO THE BMS:

A. Fire Alarm Systems

B. Lynell door locking Systems – IFMS.

C. Critical systems isolation valves:

1. Chilled Water
2. Steam & Condensate

D. Lighting Panel and meter.

E. Building dashboard system coordinate with electrical.

## 3.7 INTEGRATION OF THE FOLLOWING METERS INTO THE BMS:

A. Meters to be connected to building dashboard system for display.
B. Domestic hot water meter.
C. Domestic cold water meter.
D. Electricity meter.
E. Generator run time.
F. Chilled water meter.

G. Hydronic steam meter.
H. Airflow monitor meter on all outdoor air intakes.

## PART 4 - SEQUENCE OF OPERATION

### 4.1 GENERAL

A All HVAC Systems shall be controlled with Direct Digital Control (DDC) according to the sequence contained in this section of the specifications and shall be stand-alone. Additional points or software programming not listed in the sequence or in the schematics but which are required to meet the following sequences of operation shall be provided.

B Monitor all pumps and fans with adjustable setpoint current switches. Indicate equipment status, and generate an alarm if a motor fails or if an uncommanded change of status exists: i.e. control system sequence commands a pump to turn off, but it continues running because its starter has been locally set to the hand 'on' position, or vice-versa.

C Alarms generated on the DDC system shall be classified as critical or non-critical. Review classification of each alarm with owner. Non-critical alarms generate a message on the operator workstation designated by the owner. Critical alarms will first generate a message on the operator workstation. If the alarm has not been manually cleared within 5 minutes (programmable), the system will automatically generate an email or text message alarm to a pager or mobile phone of the owner's choosing.

D The term 'enabled', as used in these control sequences, means a piece of equipment is capable of being turned on by the BAS. It does not mean it has been turned on by the BAS.

E All setpoints are programmable

F Note that some sequences of operation are shown on the drawings. Any supplemental sequences required for operation of the system will be provided by the controls contractor.

### 4.2 CHILLED WATER

A. The chilled water will be circulated through the air-handling units' and fan coil units' 2-way valves whenever the unit is running and calling for cooling.

B. Furnish a BTU meter for monitoring of building chilled water usage and energy consumption, both in instantaneous flows (GPM) as well as cumulative flows in gallons. The meter will be tied into the building DDC system and also have manual readout at the meter.

### 4.3 HOT WATER SYSTEM

A. Hot water system to run as is currently.

B. Furnish and install a current sensor on each pump for remote status monitoring by the NCP.

C. Hot water pump VFD's shall be modulated to maintain a differential set point of 20 psi (programmable).

D. The BMS shall monitor any alarms available on the pump package.

## 4.4 DOMESTIC HOT WATER CONTROL

A. This contractor shall furnish an Onicon domestic water flow meter for monitoring.

B. The circulation pumps shall be enabled from an aqua-stat located on the return line.

C. There is one electric water heater in the building that will maintain 140 Deg F domestic water set point.

D. Furnish and install a flow meter to monitor and report building domestic water consumption. The meter will be tied into the building DDC system and also have manual readout at the meter.

## 4.5 EXTERIOR LIGHTING CONTROL

A. This contractor shall coordinate with the Division 16 contractor for lighting control interface.

B. The exterior lighting shall be controlled by the facility management system via photocells provided by Div. 16000.

C. When light levels are low, the exterior lights shall be on and stay on until light levels are high enough that exterior lights are no longer required.

D. Furnish a control relay with manual override to override the exterior lighting if the FMS network is not operating.

E. Provide positive status of each exterior lighting circuit and alarm all operator workstations if a circuit is commanded on and not functioning.

## 4.6 EMERGENCY GENERATOR

A. The BMS system shall have the ability to remotely start the emergency generator.

B. The BMS system shall monitor generator status and generator alarms for monitoring, alarming, and runtime totalization.

## 4.7 POWER METER

A. Furnish and install a Veris full data meter to monitor and report building electrical consumption.

## 4.8 SYSTEM INTEGRATION

A. Building DDC system to be 100% integrated into the campus central control system.

## 4.15 FIRE ALARM SYSTEM

A. The fire alarm contractor shall provide a “dry” set of contacts to tie into the central campus annunciator panel.

## 4.16 POWER METER

A Furnish and install a Veris full data meter (N2 compatible) to monitor and report building electrical consumption.

## 4.17 STEAM FLOW METER

A Furnish a steam flow meter (N2 compatible) for monitoring of building steam usage.

## 4.18 CHILLED WATER BTU METER

A Furnish a BTU meter (N2 compatible) for monitoring of building chilled water usage and energy consumption.

## 4.19 DOMESTIC WATER METER

A. Furnish and install a flow meter (N2 compatible) to monitor and report building domestic water consumption.

## 4.20 EXISTING SWIMMING POOL

A. Furnish and install a temperature sensor for the pool water and display on graphics screen.

**END OF SECTION**

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# SECTION 23 2113

# HVAC PIPING AND SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Electronic Controls
Section 232123 - HVAC Pumps
Section 233300 – Ductwork and Accessories
Section 233400 - Air Handling Fans
Section 235700 - Heat Transfer
Section 236400 - Refrigeration

C. Work installed but furnished under other Sections:

1. Pot Feeders, Water Meters, Solenoid Water Valves with Strainers and Manifolds furnished under Section 232500 - HVAC Water Treatment.
2. Flexible pipe connectors - Section 230540
   Section 235700 – Heat Transfer
   Section 236400 – Refrigeration
   Section 237410 – Air Handling Units with Coils
3. Flow switches in the chilled and condenser water piping.
4. Two-way automatic control valves.
5. Three-way automatic control valves.
6. Cabinet heater aquastat.
7. Unit heater aquastat.
8. Temperature sensing wells.

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Hot water heating piping system and specialties.
2. Chilled water piping system and specialties
3. Relief Valves.
4. Steam Piping system and specialties.
5. Steam Condensate Pumps.
6. Diaphragm - Type Bladder Tanks.
7. Air Vents.

8. Air Separators.
9. Air/Dirt Separators
10. Strainers
11. Pump Suction fittings.
12. Radiator Valves.
13. Water Storage Tanks
14. Valves in accordance with Section 230529.
15. Pipe hangers and supports, saddles and shield in accordance with Section 230529.
16. Expansion joints, anchors and guides.
17. Mechanical sound and vibration control in accordance with Section 230540.
18. Installation of automatic control valves.
19. Flow Measuring Stations.
20. Water Meters.
21. Tests.

## 1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an NCPWB Certified Welder with current certificate in accordance with ANSI B31.9 for shop and project site welding of piping work.

## 1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American Welding Society (AWS) National Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, B31.9 as applicable for welding requirements.
2. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.
3. ANSI/ASME - Boiler and Pressure Vessel Code.
4. ANSI/ASME B31.9 - Building Services Piping.
5. ANSI/AWS D1.1 - Structural Welding Code.
6. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
7. ASTM B32 - Solder Metal.
8. ANSI/AWS A5.8 - Brazing Filler Metal.
9. ASTM F 2389-07 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
10. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
11. NSF/ANSI 14 – Plastic Piping System Components and Related Materials

## 1.5 SUBMITTALS

A. Submit Shop Drawings for the following items under provisions of The General Conditions of the Contract.

1. Heating water system pumps.
2. Chilled water system pumps.
3. Condenser water system pumps
4. Water Storage Tanks.
5. Plastic piping distribution system, including expansion details

B. Submit Product Data for the following items under provisions of The General Conditions of the Contract.

1. Diaphragm-Type Bladder Tanks.
2. Air Separators.
3. Strainers.
4. Flow Indicators, Flow Switches.
5. Flow Measuring Stations.
6. Flow Meters.
7. Balancing Valves.
8. Plastic piping
9. Thermometers.
10. Pressure Gauges.
11. Expansion Joints and Guides.
12. Backflow Preventer.
13. Blowdown Separator.
14. Pressure Regulating Valves.
15. Water Meters.
16. Water Storage Tanks.
17. Steam Traps
18. Steam System Moisture Separators

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500.

1. Diaphragm-Type Bladder Tanks.
2. Air Separators.
3. Strainers.
4. Flow Indicators.
5. Flow Measuring Stations.
6. Flow Meters.
7. Balancing Valves.
8. Water Meters.
9. Expansion Joints and Guides.
10. Backflow Preventer.
11. Blowdown Separator.
12. Pressure Regulating Valves.
13. Steam Traps

D. Delegated-Design Submittal:

1 Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2 Locations of pipe anchors and alignment guides and expansion joints and loops.
3 Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4 Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

E. Test Reports: Submit certified test reports for the following showing compliance in accordance with the General Conditions of the Contract:

1. Piping pressure tests.
2. Piping systems cleaning and flushing per Section 232500.

3. Certificates: Before proceeding with the Work, submit to the Architect/Engineer/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

## 1.6 PROJECT CONDITIONS

A. Contractor shall not fabricate or install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

## 1.7 SEQUENCING/SCHEDULING

A. Coordinate any system shutdown with Campus Project Manager not less than 7 days prior to prooposed shutdown.

# PART 2 - PRODUCTS

## 2.1 HEATING WATER, CHILLED WATER PIPING (90-200 PSIG)

A. Pipe:

| | |
|---|---|
| 2 Inch or smaller | ASTM A53, Schedule 80 black buttweld or continuous welded steel. |
| 2 Inch or smaller | ASTM A53, Grade A, Schedule 80, black CWS, CWR, HWS, HWR screwed malleable iron fittings. |
| 2-1/2 Inch or larger | ASTM A53, Grade A or B, Schedule 40 black seamless steel or continuous welded steel. |

B. Fittings: 300 psi rated.

| | |
|---|---|
| 2 Inch or smaller | ASTM A197, A234, Class 250, Schedule 80 weld fittings. |
| 2 Inch or smaller CWS, CWR, HWS, HWR | ASTM A234, Grade A, Schedule 80, black, malleable iron screwed. |
| 2-1/2 Inch or larger | ASTM A234, Grade A, Schedule 40 weld fittings. |

C. Unions:

| | |
|---|---|
| 2 Inch or smaller | Class 250, Schedule 80, black malleable iron screwed bronze to iron, ground joint. |
| 2-1/2 Inch or larger | Use Schedule 40 flanges. |

D. Gaskets:

| | |
|---|---|
| All Sizes | Class 250,1/8 inch full faced metal spiral wound, 304 stainless steel and flexible graphite filled with entering ring and inner ring. |

E. Bolting: ASTM A370, Grade B, regular square head machine bolts with heavy hex nuts.

F. Flanges:

| | |
|---|---|
| All Sizes | ASTM A181, Grade 1, Class 250 slip-on or weld neck flat faced. |

## 2.2 HEATING WATER, MEDIUM PRESSURE STEAM, SOLAR SYSTEM FLUID, PIPING (LESS THAN 90 PSIG)

A. Steel Pipe:

1. Pipe:

| | |
|---|---|
| 2 Inch & Smaller | ASTM A53, Grade A, Schedule 40 black buttweld or continuous welded steel. |
| 2-1/2 Inch & Larger | ASTM A53, Grade B, Schedule 40 black buttweld or continuous welded steel. |

2. Fittings:

| | |
|---|---|
| 2 Inch & Smaller | ASTM A197, Class 150 black malleable iron screwed. |
| 2-1/2 Inch & Larger | ASTM A234, Steel butt weld, standard weight forged fittings. |

3. Unions:

| | |
|---|---|
| 2 Inch & Smaller | Class 150 black malleable iron screwed bronze to iron, ground joint. |
| 2-1/2 Inch & Larger | Use flanges or grooved couplings. |

4. Gaskets:

| | |
|---|---|
| All Sizes | Class 250 1/8 inch full faced metal spiral wound, 304 stainless steel and flexible graphite filled with entering ring and inner ring. |

5. Bolting: ASTM A307, Grade B, regular square head machine bolts with heavy hex nuts.

6. Flanges:

| | |
|---|---|
| All Sizes | ASTM A181, Grade 1, Class 150 slip-on or weld neck flat faced. |

B. Copper Tubing:

1. Tube:

Up to 4" inclusive ASTM B 88, Type L, hard drawn.

2. Fittings:

a. ANSI/ASME B16.23 cast brass and/or
b. ANSI/ASME B16.29 solder wrought copper
c. ProPress fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

3. Joints:

a. ASTM B32, solder, Grade 95 TA.
b. ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117 for ProPress Fitting connections.

## 2.3 GROOVED PIPE OPTION IN BUILDING

A. General: At Contractor's option, chilled water piping may be mechanical roll grooved pipe couplings, fittings and butterfly valves.

B. Acceptable Manufacturers: Victaulic, Anvil/Gruvlok, Grinnell.

C. Piping includes risers, mains, equipment connections, branches, supply and return lines under operating conditions not exceeding minus 30 degrees Fahrenheit to plus 230 degrees Fahrenheit.

1. Pipe: ASTM A53, 3/4 inch to 1-1/2 inch Type F; 2 inch to 20 inch Type E or S, Grade B Standard roll grooved to coupling manufacturer's specification, standard weight steel pipe.
2. Couplings: Line and fitting joints to be Victaulic "Style 75 or 77" with Grade "E" gaskets and nuts and bolts. Rated –30°F. to 230°F, or Central Sprink “Style 705 or 707" or Gruvlok 7001.
3. "Rigid" line fitting and valve joints to be Victaulic "Style S-07" Couplings with or Grade "E" gaskets and nuts and bolts or Gruvlok 7401.
4. Joints designated Outlet Couplings to be Victaulic "Style 72" with Grade "E" gaskets and nuts and bolts or Gruvlok 7042.
5. Joints designated Reducing Couplings to be Victaulic "Style 750" with Grade "E" gaskets and standard nuts and bolts or Gruvlok 7010.
6. Flanged components connections to be Victaulic "Style 741 Vic-Flanges" with Grade "E" gaskets or Gruvlok 7012.
7. Fittings: Fittings to be Victaulic or Gruvlok "Full Flow" malleable iron or ductile iron or segmentally welded fittings, with grooved or shouldered ends.
8. Valves: Butterfly valves 2" - 12" inch to be Victaulic S/300 or Gruvlok 7700 with 300 psi rating, latch-lock throttling handles, Grade "E" linings and standard trim. Sizes 14" - 24" to be Victaulic S/708 with 175 psi rating. Valves greater than or equal to 8” shall be supplied with gear operator.
9. All materials to be manufactured in the USA, and must be designed and intended for use on HVAC systems. No fire sprinkler parts are allowed.

## 2.4 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments, Miljoco.

B. Schedule: All gauges will be liquid filled.

| Plan Code | PG-1 | PG-2 |
|---|---|---|
| Type | 4-1/2” Dial | 4-1/2” Dial |
| Bourdon tube/socket | Phosphor bronze tube brass socket | Stainless steel tube 316 stainless steel socket |
| Accuracy | ANSI B40.1 Grade 1A 1% FS over middle half of range | ANSI B40.1 Grade 1A 1% F.S. over middle half of range |
| Case | Cast aluminum | Cast aluminum |
| Window | Clear glass | Clear glass |
| Snubber | Yes | Yes |
| Coil siphon | For steam service | For steam service |
| Gauge cock | Yes | Yes |
| Set hand | No | No |
| Silicone filled | No | No |
| Weatherproof | No | No |

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems:

1. Domestic Water 0 to +160 psi
2. Pump Gauges -30 in Hg to +100 psi
3. Steam -30 in Hg to +150 psi

D. Include a siphon tube and gauge cock on all pressure gauges used on steam systems. Syphon must be filled with water.

## 2.5 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

| Plan Code: | T-1 |
|---|---|
| Type | Adjustable angle |
| Case | 9" cast aluminum |
| Window | Clear acrylic |
| Tube | Thermistor |
| Stem | Aluminum, insertable |
| Separable Socket | Brass |

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

| | | |
|---|---|---|
| 1. | Condenser water | 0 to 100 °F |
| 2. | Heating water | 30 to 240 °F |
| 3. | Reclaim water | 0 to 100 °F |
| 4. | Domestic cold water | 0 to 100 °F |
| 5. | Domestic hot water | 30 to 240 °F |
| 6. | Steam | 50 to 400 °F |
| 7. | Low Pressure steam | 30 to 300 °F |
| 8. | Steam condensate | 30 to 240 °F |

## 2.6 STEAM CONDENSATE RETURN PIPING

A. Steam condensate return piping shall be the same as steel low pressure steam piping specification except that all piping shall be Schedule 80 with extra heavy fittings.

## 2.7 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment (Pete's Plug), Sisco.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge, gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

| PLAN CODE: | MAKE: | MODEL: | PRESSURE & TEMPERATURE TEST KIT |
|---|---|---|---|
| T&PTP | Trerice | D3741 | Trerice D3750 (0-100 psig) |

## 2.8 STEAM TRAPS

A. Acceptable Manufacturers: Armstrong, Hoffman/ITT, Spirax Sarco, Watson McDaniel.

B. Thermodynamic Traps:

1. ASTM stainless steel body and insulated cap with hardened stainless steel disk and seat, capable of maximum operating pressure of 450 psig and maximum operating temperature of 750°F.
2. Include stainless steel Universal Swivel pipeline connector with integral “Y” strainer, blowdown valve, and hose fitting. “Y” strainer to be equipped with stainless steel screen with 1/32” perforations. Trap is fastened to pipeline connector with two steel bolts, allowing trap to be removed/replaced without disturbing any piping. Contractor is responsible for ordering pipeline connectors with correct hand so trap is accessible and not located between piping and wall.

## 2.9 EXPANSION JOINTS, ANCHORS AND GUIDES

A. Approved Manufacturers: Barco, Flex-Hose, Metraflex, Hyspan.

B. Provide expansion joints where called for on drawings or otherwise necessary to prevent noise or damage.

C. Exposed Bellows Expansion Compensator: Stainless steel bellows with internal stainless steel liner, carbon steel ANSI flanges or Schedule 80 beveled weld ends as indicated in schedules. Include tie rods with spacers to prevent over-elongation and over-compression of the unit. Expansion compensator must be rated for operating temperatures up to 600°F and operating temperatures up to 150 psi.

D. Externally Pressurized Expansion Compensators: Stainless steel multi-ply bellows with internal guides, internal stainless steel liner, and a heavy wall outer housing designed for line pressure. Operating fluid pressure inside compensator is transferred to the outside of the bellows through a gap between internal guide flange and the outer housing. Entire assembly to be sealed to contain fluids and pressure, and shall include a drain port in the outer housing. Unit to be rated for operating pressure of 150 psi and operating temperature up to 700°F. Unit to be a packless design, maintenance free design. Guarantee a minimum of 10,000 full travel cycles without failure. Use Metraflex Metragator, Flex-Hose Flexpress, or equal from list of approved manufacturers.

E. Braided Pipe Seismic Connectors: Two or three equal lengths of annular corrugated flexible stainless steel hose with stainless steel overbraid and four stainless 90° elbows, resulting in a device that absorbs/compensates for pipe motion in all 6 degrees of freedom simultaneously. Device shall allow for ± 4” of pipe motion in any direction. Unit to be rated for operating pressures of 150 psi and operating temperatures of 600°F. Include support lugs on elbows and fitting on distant elbow for drain plug or air relief valve. Use Flex-Hose, Tri-Flex Loop or equal from list of approved manufacturers.

F. Pipe Guides/Anchors: Provide pipe guides and anchors as shown on drawings or as recommended by expansion joint manufacturer. Pipe guides must allow axial movement of pipe while eliminating lateral pipe movement. Guides to be constructed of painted carbon steel, and consist of a two-piece split spider clamp that bolts around the pipe, and a two-piece bolted split housing with integral base that anchors the unit to the structure. Pipe anchors shall be made of carbon steel, are to be welded or fixed to the pipe they serve, and are to be painted to protect the anchor and welds from corrosion. Anchors to include an integral base that bolts to the structure.

## 2.10 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded to asbestos.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomer composition sealing gasket for operating temperature range from -30 degrees F to 230 degrees F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

## 2.11 RELIEF VALVES

A. Acceptable Manufacturers: Kunkle, Watts, McDonnell and Miller, Lonegren, Conbraco, Spirax Sarco.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

C. Size as required for maximum operating pressure and heat transfer capacity of the equipment. Provide relief valve in each system to protect piping, tanks, and equipment.

D. Include a drip pan elbow on all steam system relief valves. Pipe drip pan drain to nearest floor sink.

## 2.12 PUMP SUCTION FITTINGS

A. Acceptable Manufacturers: Bell and Gossett, Armstrong, Paco, Allis Chalmers, Weinman, Peerless, Aurora, Amtrol, Wheatley, Taco, Victaulic, Gruvlok, Patterson, Gustin Bacon.

B. Pump suction fitting inlet size shall match line size and outlet size and shall match specified pump provided by Contractor.

C. Selection Criteria: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120% of the scheduled head with only a change of impeller size.

D. Motor to be non overloading throughout the range of the pump curve and in accordance with “Motors” in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

E. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, or grooved fittings for grooved pipe, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

F. Maximum allowable pressure drop across pump suction fitting at system design flow is 1 psi. Provide reducer as necessary to connect pump suction to pump inlet.

G. Accessories: Adjustable foot supports, blowdown tapping in bottom, gauge tapping in side.

## 2.13 FLOW INDICATORS

A. Acceptable Manufacturers: Bell & Gossett, Taco, Weinman, Grudfos, Paco, Flo Fab, McDonnell and Miller, Mueller.

B. Brass construction, threaded for insertion into piping system, packless, with paddle with removable segments, vapor proof electrical compartment with switches.

## 2.14 IN-LINE TYPE WATER PUMPS

A. Approved Manufacturers: Bell & Gossett, Armstrong, Taco, Paco, Grundfos, Patterson.

B. Selection Criteria Variable Speed Pump: Pumps shall be selected with the largest impeller available in the scheduled casing size. Submit pump selection indicating pump speed required to deliver scheduled flow and head.

C. Selection Criteria Constant Speed Pump: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid-range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120 % of the scheduled head with only a change of impeller size.

D. Type – Pumps shall be selected for quiet operation. Pump curve shall be submitted for review, capacities and model number as shown on Drawings.

E. Motor to be squirrel cage induction type, with ODP enclosure and in accordance with "Motors" in Section 230529

F. Pump Shaft – Shall be alloy steel, and shall have bronze sleeve-type bearings. Pumps seal shall be of the mechanical type.

G. Motor: Shall be quiet operating type, 1750 RPM in accordance with "Motors" in Section 230529.

## 2.15 STEAM PRESSURE POWERED CONDENSATE RETURN PUMPS

A. Approved Manufacturers – Spirax Sarco or approved equal.

B. General: Provide automatic simplex condensate pump package with receiver and steam pressure powered pump of size and capacity scheduled on Drawings. Entire pump and receiver assembly to be factory mounted on a steel stand that locates the receiver at the correct elevation with respect to the pump for proper condensate flow and pump operation. Supply complete with vented receiver as a prepiped packaged unit with stainless steel check valves, sight glass gauge, and isolation valves. Steel receiver shall include an overflow fitting that can be connected to a separate back up electric condensate pump (not part of the pressure pump package).

C. Pump to operate with steam or compressed air up to 125 psi pressure, and shall not require any electricity to operate. Pump shall be made of cast iron and shall have a float operated snap acting mechanism with no external seals or packing, stainless steel trim, and hardened stainless steel mechanism bearing components.

D. Include a pump body insulation cover and cycle counter to monitor pumping cycles.

## 2.16 AIR ELIMINATORS

A. Air Eliminators, heating water: Steel, max. working pressure 150 psi, ASME stamped, max. working temp. 270°F, turbulence suppressive design, integral air chamber with automatic vent valve, skimming valve, blowdown connection.

B. Acceptable manufacturers: Spirotherm - Spirovent Senior, Wessels.

## 2.17 STRAINERS

A. Acceptable Manufacturers: Armstrong, Boylston, AW Cash, ITT, Hoffman, Keckley, Mueller, Trane, Metraflex, Victaulic, Gustin-Bacon, Conbraco, Spirax Sarco, Gruvlok, IFC.

B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch: Flanged or grooved iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Flanged or grooved iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

## 2.18 DIAPHRAGM-TYPE BLADDER TANKS

A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Woods, Taco, Wheatley, Armstrong, Flexcon, Wessels, Patterson.

B. Provide tanks of size and capacity shown on Drawings.

C. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM bladder sealed into tank, and steel legs or saddles.

D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to required psig.

## 2.19 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/4 inch copper tubing to a floor drain or sink with petcock at working level, ground.

B. Balanced Pressure Thermostatic Air Vents for Steam Systems: Self-adjusting balanced pressure thermostatic type with stainless steel bellows. Stainless steel head and seat, cast iron body. All internals must be accessible for maintenance.

## 2.20 STEAM SYSTEM MOISTURE SEPARATOR

A. Iron body with high efficiency internal baffles and a pressure drop not exceeding an equivalent length of pipe. Include bottom drain for installation of steam trap. Spirax Sarco Type S or equal.

## 2.21 RADIATOR VALVES

A. Acceptable Manufacturers: Dunham-Bush, ITT, Hoffman, Illinois, Trane, Danfoss, Weksler, Runtal.

B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psig working pressure, with bronze body and integral union for screwed connections, renewable

composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

## 2.22 PRESSURE COMPENSATING FLOW CONTROL VALVES

A. Acceptable Manufacturer: Griswold Corporation, Febco, Bell & Gossett, Armstrong, Gerand, Spirax Sarco.

B. Provide automatic pressure compensating flow control valves. The F.C.V. and housing shall be in a factory-assembled unit consisting of a flow controller with bronze union fittings with EPR "0" -ring seals, pressure and/or temperature plugs and ball valve. Flow control valves shall have the flow rates and pressure differential as indicated and strictly conform without exception to the following:

1. The control mechanism of the F.C.V. shall be a coiled/helical spring 17-7 PH. Wave springs are not acceptable. The cartridge for the coiled/helical spring shall be stainless steel. Plated materials are not acceptable. Cartridge must be removable in one piece.
2. Flow control valves must be available in four pressure differential operating ranges:

   1 to 14 PSI Drop
   2 to 32 PSI Drop
   3 to 57 PSI Drop
   4 to 128 PSI Drop

3. They shall be factory calibrated and automatically limit the rate of flow to the design flow rate indicated on the Drawings within + or - 5 percent accuracy over an operating pressure differential of at least 14 times the minimum required for control.
4. F.C.V. with an operating pressure differential of one range from 3 to 40 PSI Drop are not acceptable.
5. F.C.V. manufacturer shall warranty to the owner the F.C.V. for a period of two years from date of purchase.
6. All flow control valves shall have two union fittings to provide easy access and removal of the flow control from either the supply or return pipeline.
7. Each automatic flow control valve shall be furnished with a valve kit consisting of 1/4 inch by 2 inch minimum size nipples, quick-disconnect valves (to be located outside of insulation), and fittings suitable for use with the measuring instruments specified.
8. Provide a metal identification tag, with wire, for each flow control valve. The tag to be marked with zone identification, valve model number and rated flow in GPM.
9. All automatic flow controls shall be factory marked to show the direction of flow.
10. A flow pressure and temperature measuring kit shall be furnished to the owner upon completion of the job.
11. The pressure/temperature kit shall be portable and consist of pressure gauges, thermometer, connections and a carrying case.
12. Correct flow shall be verified by establishing that the operating pressure differential across the valve tappings is within the operating range indicated on the submittal data sheet for that model number.
13. Temperature measurement is to be determined by insertion of a thermometer into the fluid media via the temperature plug.

## 2.23 FLOW MEASURING STATIONS (VENTURI)

A. Furnish and install for each heating water, chilled water, and condenser water system where shown on drawings, complete Barco Venturi Flow Measuring System as manufactured by Hyspan Barco, Flow Design, Febco, Bell & Gossett, Preso, Armstrong, Gerand.

B. Each primary flow element shall be a Venturi selected from manufacturer's engineering data to permit prescribed flow at a minimum of head loss. The beta ratio shall be selected to allow for a differential pressure compatible with the meter as specified herein and insure a properly calibrated system accuracy within 1% throughout the entire range. Each Venturi shall be furnished with 2 built-in sensing taps, nipples, shut-off valves, and quick connect couplings. Venturis shall be complete with identification tag on chain, giving pipe size, Venturi series, station identification and meter reading at specified flow rate. Furnish flow vs. differential pressure curves and installation instructions.

C. Venturi stations shall be one-piece bronze threaded 1/2" through 3". Sizes 2-1/2" through 3" shall consist of one-piece cadmium plated cast steel Venturi with weld neck or flanged ends.

D. Venturi sizes and beta ratios shall be selected so that design flow rates shall read between 20% and 80% of the full scale range on a linear meter with permanent pressure loss of not more than 25% of indicated flow rate differential pressure.

E. Provide with portable indicating meter with 6” round dial, 270 degrees indication. It shall be the dual rupture-proof liquid filled bellows type with integral temperature compensation. The meter shall have over-range protection in either direction equal to the working pressure equivalent of the instrument housing (250 psig at 250 deg.F). The accuracy of the meter shall be no less than 0.5% full scale. The meters case shall be waterproof coated with appropriate paint. It shall have external zero and range adjusting screws and life-long lubrication. Scale shall be calibrated uniformly either in differential pressure; percent of flow; or directly in gpm.

1. Portable Master Meters shall be mounted in a durable metal reinforced plastic carrying case with the following accessories:

   a. Two 10” lengths of connecting hose, each with color coded quick connect couplings compatible with the Venturi couplings.
   b. Two brass blow-down valves with Buna-N seals.
   c. Blow-down hoses.
   d. Instruction book with flow vs. differential curves.

## 2.24 BALANCING VALVES (TERMINAL EQUIPMENT)

A. Acceptable Manufacturer: Bell & Gossett, Gerand, Armstrong, Taco, Amtrol, Tour & Andersson, Flow Design, Gruvlok, Danfoss.

B. Furnish and install calibrated balancing valves with screwed, sweated, or flanged connections suitable for 125 psig. Maximum working temperature shall be 250°F. Valves shall be equipped with brass readout valves fitted with an integral EPT insert and check valves designed to minimize system fluid loss during the balancing and monitoring process. Each balancing valve shall have a calibrated nameplate to assure specific valve settings, be constructed with internal seals to prevent leakage and be supplied with preformed Polyurethane insulation suitable for use on heating and cooling system.

C. Provide a metal identification tag, with wire, for each flow control valve. The tag to be marked with zone identification, valve model number, and rated flow in GPM.

D. Correct flow shall be verified by establishing that the operating pressure differential across the valve tappings is within the operating range indicated on the submittal data sheet for that model number.

## PART 3 - EXECUTION

### 3.1 PIPE WORKMANSHIP

A. Piping shown on the drawings shall be installed complete, and shall be of the size shown on the drawings. When a size is not indicated, the sub-contractor shall request the pipe size from the Architect/Engineer thru the General Contractor. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion. Install saddles and shields per Section 230529.

B. Relief Valve: Install a 1” safety relief valve, set at a pressure no more than 5 psig less than the relief valve on boiler or chiller evaporator barrel, to protect against damage by expanding liquid or other source of overpressure during test or normal operation. Discharge of this system relief valve shall be piped to the glycol fill tank for recovery of glycol should relief valve be discharged.

### 3.2 PIPE SLOPE

A. Slope all domestic water, chilled water, heating water and condenser water piping at 1”/40’ toward drains.

### 3.3 PIPING JOINTS

A. All pipe shall be reamed to full pipe diameter before joining. Screwed joints shall be made with standard pipe thread, and an approved compound applied to the male thread only. Welded joints shall be made in accord with the procedure outlined in National Certified Pipe Welding Bureau, or by other reputable testing laboratory or agency. Subcontractor shall use only "Threadolet" or "Weldolet" fittings for intersection welding of branches to mains. Valves and specialties shall have screwed or flanged joints. No bushings allowed.

B. All pipe shall be reamed to full pipe diameter before joining. ProPress fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect™) feature design (leakage path). In ProPress ½” to 4” dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

C. Pull tee (T-drill) fittings are forbidden.

D. Fusion welding of PP-R joints

1. Install fittings and joints using socket-fusion, elecrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.
2. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
3. Prior to joining, the pipe and fittings shall be prepared in accordance with F 2389 and the manufacturer's specifications.
4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

## 3.4 STEAM SYSTEM STRAINERS

A. Install steam strainers on side so branch of "Y" lies on horizontal plane, not down.

B. Strainers in condensate drip legs will primarily see condensate and are to be installed with the branch of the "Y" in the vertical plane, pointing down.

## 3.5 PIPING INSTALLATIONS

A. Install hangers and supports at intervals specified in the applicable Plumbing or Mechanical Code and as recommended by pipe manufacturer.

B. Support vertical piping at each floor and as specified in the applicable Plumbing or Mechanical Code

E. Fire stopping shall be provided to both be compatible with the PP-R Piping and meet the requirements of ASTM E 814 or ULC S115 , "Fire Tests of Through-Penetration Firestops". Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.

## 3.6 SYSTEM PRESSURE SETTINGS

A. Hot Water Heating System: Set pressure reducing fill valve or glycol fill system to maintain 10 psig at highest point in system. Pre-charge bladder-type expansion tank to 2 psig less than "fill" pressure prior to connection to the system.

B. Slope all domestic water, heating water, and condenser water piping at 1"/40' toward drains.

## 3.7 RELIEF VALVES

A. Provide a pressure relief valve in each closed loop system set at 1.2 times the maximum operating pressure.

## 3.8 EXPANSION JOINTS, ANCHORS AND GUIDES

A. Pipe anchors shall be installed as shown and at the closest feasible point to all changes in pipe direction and elevation and at main branch take-offs, except at expansion loops. All piping shall be supported, anchored, braced and guided to control expansion-contraction and pipe movement due to pressure or shock, and to result in quiet operation.

## 3.9 BALL JOINTS

A. Install ball joints and anchoring for piping where it crosses expansion joints of building.

## 3.10 AUTOMATIC CONTROL VALVES

A. Install automatic control valves as required and specified in Section 230900 - Electronic Controls.

## 3.11 AIR VENTS

A. At all changes in elevation downward in direction of flow, and where shown, provide a manual air vent as follows: install a full size air chamber and pipe down with 1/4 inch copper tubing to a petcock. If the vent is above a ceiling, install the petcock just above the ceiling. Provide air vent fittings (manual) on hydronic coils.

## 3.12 PIPING CONNECTORS

A. Install flexible pipe connectors at equipment coils and pumps and elsewhere as required to accommodate thermal expansion, misalignment and vibration in accordance with Section 230540 - Mechanical Sound and Vibration Control.

## 3.13 PUMP SUCTION FITTINGS

A. Install pump suction (eccentric reducer) and discharge (concentric increaser)

B. Pumps and motors to be leveled and aligned on bases and foundation pads in strict accordance with the manufacturer's instructions and within their recommended tolerances using an indicating micrometer. This is to be done before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced, that shaft rotates freely when turned by hand, and that pump is quiet in operation. When adjustmenst are completed, tightly bolt and grout motor and pump.

## 3.14 IN-LINE TYPE WATER PUMPS

A. Each pump shall be installed with piping or pump shaft dead level fittings as shown detailed on drawings, and shall not touch nor rest on any part of building structure. Pumps 3 HP and over shall be within 4 feet above finished floor for ease of servicing.

B. Electrical connection to Provide adequate clearance for strainer removal.

## 3.15 AIR SEPARATOR / AIR DIRT SEPARATOR

A. Contractor shall remove and clean strainer after 24 hours operation and after 30 days.

## 3.15 FLOW SWITCHES

A. Contractor shall furnish and install flow switches for mounting in chilled water and condenser water piping of each chiller machine.

## 3.16 THERMOMETERS AND PRESSURE GAUGES FOR BOILER, HEAT EXCHANGER INSTALLATION

A. Contractor shall furnish and install a set of four adjustable, indicating type, self-powered digital thermometers of the separable socket adjustable type in glass faced metal cases. They shall be placed in the piping adjacent to the machine in the following locations or heat exchanger as indicated in the details:

1. Steam line entering heat exchanger.
2. Steam line leaving heat exchanger.
3. Heating water line entering boiler.
4. Domestic water line entering heat exchanger.
5. Heating water line leaving boiler.
6. Domestic water line leaving heat exchanger.
7. Where indicated on plans, details and schematics.

B. Thermometer bulb shall project sufficiently into pipe (at least 1/3 of nominal pipe diameter) to accurately measure water temperature. Cases shall clear insulation.

C. Contractor shall provide and install gauge valves and gauges so that water pressure difference across these vessels is indicated.

D. Mount thermometers and gauges in a readily accessible location and easily read in a standing position from the equipment room floor.

E. Provide a shut-off valve on the branch line to each pressure gauge located in the system.

## 3.17 BACKFLOW PREVENTER

A. Provide on cold water make-up line to heating water and chilled water piping systems. Locate on high pressure side of reducing valve on system water make-up line.

## 3.19 TESTS

A. General: Provide test pump, gauges, meters, other instruments, materials, and labor, in connection with tests.

B. Relief Valve: Install a 1” safety relief valve, set at a pressure no more than 5 psig less than the relief valve on boiler or chiller evaporator barrel, to protect against damage by expanding liquid or other source of overpressure during test or normal operation. Discharge of this system relief valve shall be piped to the glycol fill tank for recovery of glycol should relief valve be discharged.

C. Pressure Tests: Before testing piping systems, remove or otherwise protect from damage, control devices, air vents and other parts which are not designed to stand pressure used in testing piping.

D. Hydrostatic Pressure: Test hydronically, piping for all services (except pneumatic system compressed air) to 125 psi or 1.5 times the maximum working pressure, whichever is greater, for at least six consecutive hours, during which time pressure shall remain constant without pumping. Subject welded joints to the hammer test, and copper joints to soap suds while under hydrostatic pressure.

## 3.20 CLEANING OF PIPING SYSTEMS

A. Provide for the cleaning of the HVAC Water Piping Systems after hydrostatic tests have been completed and prior to the operating tests in accordance with Section 232500 - HVAC Water Treatment.

B. Pipe in parallel with the water system to be monitored in accordance with piping diagram and instructions provided by Section 232500 Contractor.

## 3.21 HVAC WATER TREATMENT

A. Provide valved tees and piping and 3/4 inch threadolets for water treatment apparatus in accordance with Section 232500 HVAC Water Treatment Contractor instructions.

## 3.22 P&T PLUGS

A. Provide P&T Plugs at all hot water and heat pump water coils, water side of heat exchangers and heat transfer devices, and where indicated on drawings.

**END OF SECTION**

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# SECTION 23 2123

# HVAC PUMPS

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1 General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 – Mechanical Seismic Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Electronic Controls
Section 232113 - HVAC Piping and Specialties
Section 233400 - Air Handling Fans
Section 235700 - Heat Transfer
Section 236400 – Refrigeration
Section 237410 – Air Handling Units with Coils

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to, providing the following:

1. Heating water chilled water pump system pumps.
2. Chilled water system pumps.
3. Mechanical sound and vibration control in accordance with Section 230540.
4. Steam condensate pumps.

### 1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

## 1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data including materials of construction, actual impeller size, pump speed, motor size, motor efficiency, motor amps, mounting requirements, weights, dimensioned drawings, and performance curves at scheduled flow conditions and 120% of scheduled head, for the following items in accordance with the General Conditions of the Contract:

1. Heating water system pumps.
2. Chilled water system pumps.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. All pumps.

# PART 2 - PRODUCTS

## 2.1 BASE MOUNTED CIRCULATING PUMPS

A. General: Provide pumps and motors of sizes and capacities scheduled on Drawings. Pump manufacturer to check suction condition on pumps, and provide pumps suitable for operation at proper net pump suction head (NPSH).

B. Selection Criteria: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid-range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120% of the scheduled head with only a change of impeller size.

C. Motor to be non-overloading throughout the range of the pump curve and in accordance with "Motors" in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

D. The pumps shall be single stage, end-suction design, in cast iron and bronze fitted constructed. The pump internals shall be capable of being serviced without disturbing piping connections or motor.

E. The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable locknut.

F. Pump seal shall be standard single mechanical seal with carbon seal ring and ceramic seat.

G. A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal or packing.

H. The bearing frame assembly of the pump shall be fitted with regreaseable ball bearings equivalent to electric motor bearing standards for quiet operation.

I. The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area. A flexible EPDM coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required.

J. The pump shall be factory tested, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time.

K. Manufacturers: Bell and Gossett, Armstrong, Taco, Paco, Allis Chalmers, Weinman, Peerless, Aurora, Grundfos, Patterson.

## 2.2 IN-LINE TYPE WATER PUMPS

A. Approved Manufacturers: Bell & Gossett, Armstrong, Taco, Paco, Grundfos, Patterson.

B. Selection Criteria Variable Speed Pump: Pumps shall be selected with the largest impeller available in the scheduled casing size. Submit pump selection indicating pump speed required to deliver scheduled flow and head.

C. Selection Criteria Constant Speed Pump: Pumps shall be selected to satisfy the specified flow/head conditions shown on pump schedule while in the mid-range of the selected pump performance curve. Pump shall be capable of delivering the scheduled flow with 120% of the scheduled head with only a change of impeller size.

D. Type - Pumps shall be selected for quiet operation. Pump curve shall be submitted for review, capacities and model number as shown on Drawings.

E. Motor to be squirrel cage induction type, with ODP enclosure and in accordance with "Motors" in Section 230529.

F. Pump Shaft - Shall be alloy steel, and shall have bronze sleeve-type bearings. Pump seal shall be of the mechanical type.

G. Motor: Shall be quiet operating type, 1750 RPM in accordance with "Motors" in Section 230529.

## 2.3 STEAM PRESSURE POWERED CONDENSATE RETURN PUMPS

A. Approved Manufacturers – Spirax Sarco or approved equal.

B. General: Provide automatic simplex condensate pump package with receiver and steam pressure powered pump of size and capacity scheduled on Drawings. Entire pump and receiver assembly to be factory mounted on a steel stand that locates the receiver at the correct elevation with respect to the pump for proper condensate flow and pump operation. Supply complete with vented receiver as a prepiped packaged unit with stainless steel check valves, sight glass gauge, and isolation valves. Steel receiver shall include an overflow fitting that can be connected to a separate back-up electric condensate pump (not part of the pressure pump package).

C. Pump to operate with steam or compressed air up to 125 psi pressure, and shall not require any electricity to operate. Pump shall be made of cast iron and shall have a float operated snap-acting mechanism with no external seals or packing, stainless steel trim, and hardened stainless steel mechanism bearing components.

D. Include a pump body insulation cover and cycle counter to monitor pumping cycles.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Provide installation in accordance with Section 230540 - Mechanical Sound and Vibration Control.

B. Lubricate the pumps in accordance with manufacturer's instructions after completion of the system and before start-up.

### 3.2 BASE MOUNTED CIRCULATING PUMPS

A. Valves and fittings in piping to pumps to be full line size with reductions made directly to pump suction (eccentric reducer) and discharge (concentric increaser).

B. Pumps and motors to be leveled and aligned on bases and foundation pads in strict accordance with the manufacturer’s instructions and within their recommended tolerances using an indicating micrometer. This is to be done before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced that shaft rotates freely when turned by hand, and that pump is quiet in operation. When adjustments are completed, tightly bolt and grout motor and pump.

C. Level and align pumps and motors on bases and foundation pads in strict accordance with the manufacturer's instructions and within their recommended tolerances using an indication micrometer. This is to be done by the pump supplier before any piping or electrical connections are made. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments. Make adjustments to assure that the thrust is balanced, that shaft rotates freely when turned by hand, and that pump is quiet in operation. When adjustments are completed, tightly bolt and grout motor and pump.

### 3.3 IN-LINE TYPE WATER PUMPS

A. Each pump shall be installed with piping or pump shaft dead level as shown on drawings, and shall not touch nor rest on any part of building structure. Pumps over 3 HP and over shall be mounted against wall and within 4 feet above finished floor for ease of servicing.

B. Electrical connection to each pump shall be made through the use of flexible conduit (Greenfield) at least 18" long.

C. Each pump shall be so installed that pump can be completely removed without dismantling or removal of any piping or valves. No additional motor support will be allowed.

D. Motor and coupling shall be checked and properly aligned in strict accord with manufacturer's instructions. Motor/pump shaft shall be vertical or horizontal as required by manufacturer.

E. Adjacent piping shall be carefully fitted and erected so that pump can be installed or removed from pipe line without forcing or springing.

F. After system has been completed and pump started, each pump and system shall be checked for vibration and excessive noise, and any such noise or vibration shall be immediately corrected.

G. Change the cartridge filter on the flush line to the seals after the system has been flushed, and immediately prior to substantial completion.

## 3.4 STEAM CONDENSATE PUMPS

A. Follow all manufacturers instructions and recommendations for installation and operation.

B. Follow all requirements of specification section 230540 – Mechanical Sound and Vibration Control.

**END OF SECTION**

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# SECTION 23 2500

# HVAC WATER TREATMENT

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Pre-Startup cleaning of HVAC Piping Systems.

1. All mechanical system piping flush out to be witnessed by the WSU maintenance personnel and the State Inspector. 48 hours notice required to schedule.

B. Pre-Startup cleaning of Boilers and Condensate Piping Systems.

C. Chemical Feeders.

D. Treatment for Closed Systems:

1. Heating Water
2. Chilled Water

E. Treatment for Steam System.

### 1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish only the following items to Section 232113 - HVAC Piping Contractor for installation:

Manifolds
Solenoid Water Valves with Strainers
Pot Feeders
Complete instruction for corrosion coupon rack
Motorized Ball Valves for solids separator blowdown/bleed

### 1.3 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 221411 - Disinfecting Water Supply System.

F. Section 232113 - HVAC Piping and Specialties.

## 1.4 QUALITY ASSURANCE

A. The Water Treatment, Chemical and Service Company shall be a recognized specialist, active in the field of industrial water treatment for at least ten years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department, plus full-time service personnel within the locale of the job site.

B. All products shall be provided by a single Contractor to ensure there being a single source of responsibility.

C. While it is recognized that there are, for most items, several equal brands and manufacturers, the bidders will for the purpose of this bid, offer only specified equipment and chemicals.

D. Acceptable Water Treatment, Chemical and Service Suppliers meeting the above requirements for this project are as follows:

1. West, Inc.

E. Campus treatment is currently West, Inc. Water treatment company providing service for this project will use compatible treatment service and follow West, Inc. standards and recommendations.

F. Firms not listed above must submit a list of satisfied customer service references and evidence of qualifications and experience for acceptance to execute the work on this project under provisions of the General Conditions of the Contract.

## 1.5 SUBMITTALS

A. Technical Data: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Water Treatment Materials and Equipment.
2. Control Diagrams.
3. Chemicals and quantity provided.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. All Water Treatment Equipment and Procedures.
2. Water Treatment Program Control Chart.

## 1.6 MAINTENANCE SERVICE

A. Provide the services of a fully qualified Field Engineer and laboratory and technical assistance from a fully qualified laboratory staff for one year warranty period. Services and assistance shall include the following:

1. A two hour training course for the Owner's operating personnel instructing them clearly and fully on the installation, care, maintenance, testing, and operation of the water treatment systems. The training course shall be arranged by the Division 23 Contractor at the startup of the system.
2. A monthly technical service visit to the jobsite of the installation to perform field inspections and to make water analysis on site, both of such complexity as to evaluate the water systems operations. The Field Engineer shall detail findings with the proper personnel in writing on proper practices, chemical treating requirements, and any corrective actions needed to protect the water systems from scale, corrosion, and fouling. Two copies of the written field service report shall be forwarded to the Owner, Division 23 Contractor and the Engineer after each visit.
3. Be on call at no additional cost increase to the Contract Sum to make on-site inspections of equipment during scheduled or emergency outages in order to properly evaluate the success of the water treatment program, and to make recommendations in writing based upon these inspections.

## 1.7 EXTRA STOCK

A. Provide sufficient chemicals for treatment and testing during one year warranty period. If any system loses the chemicals due to pipe leaks or any other system malfunction, the Division 230000 Contractor shall replace the chemicals at no expense to the Owner. Chemicals shall not be harmful to the system in which they are used, and shall comply with Jurisdictional Codes governing the use and discharge of chemical formulations.

# PART 2 - PRODUCTS

## 2.1 PRE-STARTUP CLEANER

A. Provide a pre-startup liquid alkaline dispersant cleaner for the flushing and cleaning of all HVAC water systems to remove oil and foreign matter from the piping and equipment prior to the final filling of the systems. This chemical shall not be injurious to persons, piping, pipe joint compounds, packings, coils, valves, pumps, and their mechanical seals, tubes or other parts of the system. Cleaner to be left in system for 8 hours before flushing.

B. Provide a pre-startup liquid alkaline dispersant cleaner for the flushing and cleaning of the steam system and related equipment to remove oil and foreign matter from the equipment prior to startup.

C. Furnish complete instructions dictating the quantities of the cleaner to use, methods, and duration of the operation.

## 2.2 STARTUP CLEANING OF STEAM PIPING SYSTEM

A. Provide chemicals for startup cleaning of steam and condensate piping systems. Assist installing contractor and boiler startup technician during boiler startup to conduct once through cleaning of piping systems.

## 2.3 CHEMICAL FEED EQUIPMENT FOR CLOSED SYSTEMS

A. Provide pot feeders for the following closed systems:

1. Heating Water
2. Chilled Water

B. Feeder shall be bypass Pot Feeder of sufficient capacity with 3/4" brass drain valve. All feeders shall be able to withstand a maximum working pressure of 175 psi.

## 2.4 CLOSED SYSTEM WATER TREATMENT CHEMICALS

A. Provide liquid borate nitrite corrosion inhibitor plus an azole inhibitor treatment for the prevention of corrosion in closed systems at 700 PPM total nitrite level.

B. Note that some systems contain glycol provided under HVAC Piping Section 232113.

## 2.5 WATER TREATMENT CONTROL TESTING EQUIPMENT

A. Provide testing chemicals to properly analyze the condenser water for organic phosphonate and closed system water for nitrite. Furnish the necessary test kits for these tests.

B. Provide a Myron L "DS" meter, single range, 0-5000 MICROMHOS/CM auto-temp compensation 50-160 deg.F, 9-volt transistor batteries, and built in cell cup.

C. Furnish a supply of log sheets on which to record the test results and bound copy of full test instructions.

D. Provide test kit for measuring the concentration of propylene glycol solutions, test instrument shall be of refractive index type with two-point calibration.

## 2.6 STARTUP CLEANING OF STEAM PIPING SYSTEM

A. Provide chemicals for startup cleaning of steam and condensate piping systems. Assist installing contractor and boiler startup technician during boiler startup to conduct once-through cleaning of piping systems.

## 2.7 STEAM SYSTEMS

A. Provide Chemical Feed Equipment, Control Equipment, and Chemicals for Steam Systems.

B. Acceptable Manufacturers:

Chemical Pump Package Unit: Neptune, Milton Roy, LMI.
Manual Throttling Valve: Claypool, Tasco, Packer.

C. Provide a chemical pump package unit for each boiler consisting of the following.

1. One (1) DEI ½" motorized ball valve.
2. One (1) Parker continuous blowdown valve.
3. One (1) LMI A51-257 Chemical Metering Pump including two spring loaded stainless steel check valves. Provide foot valve and suction tubing for pump. Provide all hardware to mount pump to the flat on the top of the tank. All mounting and associated hardware shall be stainless steel.
4. One (1) Aquatrac Model CPT1FL2RMAD Automatic Blowdown Controller. Provide all required surge protection and interlocks for proper operation of the controller. (One controller to monitor blowdown and chemical feed for both boilers).
5. One (1) Chemical Pump Control Panel. Panel shall be NEMA 12X Construction and shall include hand/off/auto switches and annunciator light for each pump. Pump control shall be provided by the blowdown controller through the Pump Control Panel (one chemical pump control panel to control chemical feed for both boilers).
6. One (1) Water Meter sized for boiler feed water line with a pulse signal.
7. One (1) Neptune QC-50 Injection Quills.
8. One (1) 65 gallon bulk treatment tank with secondary containment basin. Tanks shall be cross-linked HDPE. Tank shall be Snyder MST style tank within a tank. Tank shall include mounting flat for pump and Camlock connection for filling the tank. A visual level indicator shall be supplied with the tank.
9. One (1) Madden sample cooler model SC0001.
10. One (1) Keckley blowdown strainer style 1.

D. The controller shall be mounted at a height appropriate for convenient visual inspection. Controller shall incorporate the latest in solid state/microprocessor technology. Controller enclosure shall be NEMA 12X.

E. The Automatic Blowdown Controller shall include not less than 12 analog inputs, and 12 Digital inputs for system monitoring. Inputs for water meter connections shall be separate from the initial 12 digital inputs. Water meter from the make-up line of the dearator and the boiler feed water lines shall be connected and monitored by the controller. All analog inputs shall be 4-20 mA loops. The Automatic Blowdown Controller shall be provided with two (2) sensing probes. One sensor shall be installed on the surface blowdown line of each boiler.

F. Controller shall include digital display and shall be programmed through a remote infrared programmer. Infrared programmer shall be supplied with the controller and will allow programming of the controller without opening the enclosure. Data storage shall include all measured parameters and shall be stored at a minimum of 15 minute increments. Total data storage shall be held for not less than 30 days.

G. Software and hardware shall be provided with the controller to allow computerized monitoring.

H. Water treatment chemicals shall be fed on a percentage of makeup water and feed water to each of the boilers. Liquid sulfite shall be fed directly to the deaerator. Boiler treatment shall be fed into the boiler feed water line, downstream of the boiler feed water pumps and water meter.

I. All treatment materials will be delivered to the facility in portable containers which will be used only to transport treatment to the bulk storage tanks and then removed. No portable containers will be allowed to remain onsite.

J. Monthly reports will be provided to the engineer and to the owner showing all monitored treatment parameters.

K. Blowdown sensor, metering valve, and motorized ball valve shall be mounted with a three valve bypass to isolate sensor and valves for servicing.

L. Provide a second separate chemical pump package unit consisting of the following for the deaerator storage tank:

1. One (1) LMI A151-257 Chemical Metering Pump.
2. One (1) Water meter sized for makeup water line with a pulse signal.
3. One (1) Neptune QC-50 Injection Quills.
4. One (1) 65 gallon bulk treatment tank with secondary containment basin. Tanks shall be cross-linked HDPE. Tank shall be Snyder MST style tank within a tank. Tank shall include mounting flat for pump and Camlock connection for filling the tank. A visual level indicator shall be supplied with the tank.

M. Provide a separate chemical pump package unit consisting of the following for the condensate return line treatment station indicated on drawings:

1. One (1) LMI A151-257 Chemical Metering Pump.
2. One (1) programmable timer for 7 day operation with a minimum of 8 operation times per day. Timers shall be mounted in a NEMA 12X enclosure. The timer enclosure shall provide at least one outlet for the chemical metering pump. All electrical connections for the pump and the timer shall be made inside the timer enclosure.

N. One (1) pump support stand. The stand shall support the pump at a height to accommodate a 5 gallon pail underneath. The stand shall provide for mounting the timer above the pump. Stand shall be stainless steel or mild steel with an epoxy coating. Steel with enamel paint coatings will not be acceptable.

## 2.8 STEAM SYSTEM CHEMICALS

A. Provide chemicals for use in the steam system, to include scale inhibitor, Alkalinity Builder, Sludge Conditioner, Oxygen Scavenger, Condensate Line Treatment, and Corrosion Inhibitor.

## 2.9 WATER TREATMENT CONTROL TESTING EQUIPMENT

A. Provide testing chemicals to properly analyze the condenser water for organic phosphonate and closed system water for nitrite. Furnish the necessary test kits for these tests.

B. Provide a Myron L “DS” meter, single range, 0-5000 MICROMHOS/CM auto-temp compensation 50-160 deg.F, 9-volt transistor batteries, and built in cell cup.

C. Furnish a supply of log sheets on which to record the test results and bound copy of full test instructions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Coordinate where installation of equipment in piping systems is required with the Section 232113 - HVAC Piping Contractor and Electrical requirements per Section 230529 - Basic Mechanical Materials and Methods and provide installation instructions to those firms providing installation.

### 3.2 CLEANING OF PIPING SYSTEMS

A. Thoroughly clean the HVAC water piping systems after hydrostatic tests have been completed and prior to the operating tests with liquid alkaline dispersant cleaner per instructions specified in Part 2 dictating the quantities of the cleaner to use, methods, and duration of the operation. Systems shall then be drained and thoroughly flushed out with fresh water. Thoroughly clean the steam and condensate piping system and equipment.

B. Contractor shall notify Architect/Engineer prior to cleaning operation, and shall verify in writing to the Architect/Engineer after the system has been cleaned.

C. Failure of any part of the system due to improper cleaning or inadequate chemical feed shall be the responsibility of the Division 23 Contractor.

D. Division 232113 Contractor is to provide bypasses and isolation valves as required to allow circulation of cleaning solution in new piping system without allowing system cleaning solution to circulate through existing piping system. Coordinate proper bypass and isolation valve locations with Division 232113 Contractor to ensure proper cleaning of entire new HVAC piping systems.

### 3.4 SYSTEM START-UP

A. The Water Treatment Supplier shall put the treatment equipment into operation, and make adjustments necessary for proper operation.

B. The Water Treatment Supplier shall provide a written report to the Division 23 Contractor indicating that the start-up has been completed and that all equipment is operating properly.

### 3.5 OPERATOR TRAINING AND SERVICE

A. The Water Treatment Supplier shall instruct the Owner's operating personnel so as to familiarize them with all treatment equipment and procedures per Maintenance Service specified in Part 1 of this Section. Minimum of 2 hours/system type.

B. The Water Treatment Supplier shall obtain a signed receipt from the Owner's operating personnel to confirm that adequate training has been received to operate the systems properly.

**END OF SECTION**

# SECTION 23 3300

# DUCTWORK AND ACCESSORIES

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Low pressure ductwork.

B. Medium and high pressure ductwork.

C. Manufactured duct joints.

D. Casings.

E. Fibrous glass ductwork.

F. Kitchen hood exhaust ductwork.

G. Damper operator hardware.

H. Volume control dampers.

I. Fire dampers.

J. Combination fire and smoke dampers.

K. Combination fire, smoke, and control dampers.

L. Smoke dampers.

M. Gravity backdraft dampers.

N. Motorized pressure dampers.

O. Motorized backdraft dampers.

P. Insulated flexible round ductwork.

Q. Flexible duct fan connections.

R. Access door hardware.

S. Duct access doors.

T. Air Flow measuring devices.

U. Pressure relief doors.

V. Plenum air blenders.

## 1.2 PRODUCTS INSTALLED BUT NOT FURNISHED IN THIS SECTION

A. Outside, return, and exhaust air dampers for supply fan/return fan systems per Section 230900.

B. Sound attenuators per Section 230540.

## 1.3 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Division 1 – Commissioning, coordinate as required.

## 1.4 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Material and Methods.

B. Section 230540 - Mechanical, Sound and Vibration Control.

C. Section 230700 - Mechanical Insulation.

D. Section 230900 - Electronic Controls.

E. Section 230593 - Testing, Adjusting and Balancing.

## 1.5 REFERENCES AND CODE REQUIREMENTS

A. ASHRAE - Handbook 2001 Fundamentals; Chapter 34 - Duct Design.

B. ASHRAE - Handbook 2004 HVAC Systems and Equipment; Chapter 16 - Duct Construction.

C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

H. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

I. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 92A - Smoke Control Systems.
NFPA 92B - Smoke Management Systems.

L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

M. SMACNA - HVAC Duct Construction Standards.

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. SMACNA - Fibrous Glass Duct Construction Standards.

P. UL 33 - Heat Responsive Links for Fire-Protection Service.

Q. UL 181 - Factory-Made Air Ducts and Connectors.

R. UL 555 - Fire Dampers and Ceiling Dampers.
UL 555S - Leakage Rated Dampers for Smoke Control Systems.

## 1.6 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Design and Construct to SMACNA 2 in. w.g. pressure class. Low pressure duct shall include: Supply duct downstream of VAV boxes, return duct, general/toilet exhaust ducts, fresh air duct, relief duct, smoke exhaust duct and combustion air duct, unless otherwise indicated on drawings.

C. Medium Pressure: Design and Construct to SMACNA 6 in. w.g. pressure class. Medium pressure duct shall include: Supply duct from supply fan(s) to VAV box inlets including built-up plenums where applicable.

## 1.7 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

## 1.8 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated assemblies including duct or plenum access doors.
2. Duct fittings, particulars such as gauges, sizes, weld, and configuration prior to start of work for low pressure, kitchen hood exhaust systems.
3. Negative pressure relief dampers.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Combination fire and smoke dampers.
2. Backdraft dampers.

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Combination fire and smoke dampers.

## 1.9 PROJECT CONDITIONS

A. Contractor shall not fabricate or install any ductwork until he has assured himself that the ductwork can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

B. Contractor shall prepare 1/4" = 1'-0" scale shop drawings of all ductwork and plenums within confines of penthouse mechanical rooms for coordination with other trades and the Architectural and structural work.

C. Provide any and all off-sets and fittings required to coordinate with field conditions. The lack of coordination will not constitute a change in contract price. The contract drawings are of a schematic nature only, exact duct routing and field coordination is the responsibility of the Division 233300 Contractor.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

A. Nonmetallic air ducts and connectors shall conform to UL 181 Class 0 or Class 1.

B. Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating each side in conformance with ASTM A90.

C. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

D. Stainless Steel Ducts: ASTM A167, Type 304.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or all thread.

## 2.2 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures specified or as indicated on drawings.

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 turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Construct fittings with 45 degree wye or 90 degree wye with 45 degree entry.

D. Round take-offs shall be plain spin collar fittings of 90 degrees unless indicated otherwise on drawings. Round spin collar fittings serving low-pressure duct run-outs to diffusers and grilles may include damper blade with two quadrants, fully retractable zinc alloy bearings, washers, and position handle with wing nut to lock damper position. Include 2-inch position handle standoff where used on externally insulated ducts.

E. 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.

F. 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.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of airflow.

## 2.3 MEDIUM PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks. Provide duct material, gauges, reinforcing, and sealing for operating pressures specified or as indicated on drawings.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.

C. Provide conical fittings constructed to conform to details of the Sheet Metal and Air Conditioning Contractors National Association Manual (SMACNA) in branch ducts of medium pressure take-offs to VAV boxes.

D. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

## 2.4 MANUFACTURED DUCT JOINTS

A. Manufacturer: Ductmate Industries, Inc., TDF, MEZ Industries, Hercules, or approved equal.

B. Transverse duct joints of medium pressure ductwork shall be made with the Ductmate System components of standard catalog manufacture.

## 2.5 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards for 2-inwg class of not less than 18 gauge panels, unless otherwise indicated on drawings.

B. At floor, rivet or bolt panels on 8 inch centers to angles.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 6 x 8 inch size. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position. Provide a 12” x 12” viewing panel in each door with center at 4’-6” A.F.F.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge back facing in supply fan sections and elsewhere if indicated on drawings. Provide 22 gauge perforated front facing with 3/32 inch diameter holes on 5/32 inch staggered centers. Construct panels 3 inches thick packed with 4.5 lb/cu. ft. minimum mineral wool media, on inverted channels of 16 gauge.

## 2.6 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and NFPA 96.

B. Construct of 16 gauge carbon steel or 18 gauge stainless steel using continuous external welded joints.

## 2.7 DAMPER OPERATOR HARDWARE

A. Manufacturers: Ventfabrics Ventlok Regulators, Metropolitan Air.

B. Other acceptable manufacturers offering equivalent product: Duro Dyne, Daniel.

C. Regulators and End Bearings.

Damper shaft length:
12" or less - Ventlok #620 Regulator.
12" to 20" - Ventlok #635 Regulator and #607 Bearings.
Larger dampers - Ventlok #640 or #641 Regulator and #607 Bearings.

D. Provide equivalent model elevated bases for insulated ducts.

E. Provide remote damper control where any damper does not have permanent access. System to include a locking worm drive gear, ¼” flexible steel shaft and a concealed ceiling cap of 1”. Manufacturers: Young Regulator or submitted equal.

## 2.8 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 6 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

## 2.9 FIRE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS) (All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555 requirements.

B. Furnish and install, where plans show square or rectangular fire wall penetrations, fire dampers constructed and tested in accordance with the current edition of UL-555, Standard for Fire Dampers. Each fire damper shall be marked with a UL classified 1-1/2 hour fire protection rating and "for use in static systems only." In addition each fire damper shall include a 165°F fusible link. Fire dampers shall have damper blades out of air stream for minimum airflow restriction. Fire dampers shall include a factory fabricated steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with manufacturer's instructions shipped with the damper. Fire dampers shall be equivalent to Ruskin model IBD2 "B" Style.

C. Where plans show round or oval fire wall penetrations, furnish and install fire dampers as described above except that fire damper shall have damper frame and blades completely out of air stream for minimum air flow restriction. Damper shall include a factory fabricated fully welded and sealed steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with these instructions. Fire dampers shall be equivalent to Ruskin model IBD2 "CR" or "CO" Style.

D. Ducts connecting to sleeves shall be equal to or less than the sleeve thickness. Sleeve gauge requirements are listed in the SMACNA Fire, Smoke and Radiation Damper Installation Guide and outlined in NFPA 90A. If any other duct to sleeve connections are used, sleeve shall be 16 ga. minimum for dampers up 36"x24", and 14 ga. if damper width exceeds 36" or damper height exceeds 24".

E. Where job conditions require vertical dampers larger than manufacturer's maximum UL tested sizes, contractor will provide and install fire rated mullions in accordance with fire damper manufacturer's instructions.

F. Where duct gauges allow their use, contractor may, at his option, install square or rectangular fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Retaining angles shall be furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions and the dampers shall be installed in accordance with these instructions. Fire dampers shall be Ruskin model IBD20, IBD40, or IBD60 "B" Style. Where round or oval duct gauges allow their use, contractor may, at his option, install round or oval fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Installation shall be as described above. Sleeves shall be factory sealed airtight. Fire dampers shall be equivalent to Ruskin model IBD20, IBD40, or IBD60 Style "LR" or "LO."

G. Contractor may, with engineer's approval, use certain models of dampers that afford ease of installation and labor savings such as dampers designed for grills, dampers with S-and-Drivemate breakaway connections, or dampers designed for metal stud wall applications. Install as described above per the manufacturer's UL installation instructions.

## 2.10 SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS) (All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL 555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, Ruskin model SD-60 or equivalent smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. Each smoke damper shall be equipped with a factory supplied and mounted 24v electric actuator to close the smoke damper during test, smoke detection, power failure.

## 2.11 CORRIDOR FIRE/SMOKE DAMPERS

A. Acceptable manufacturers: Meet UL requirements for a "Corridor Damper."

B. Where tunnel corridor penetrations are square or rectangular, furnish and install at locations shown on the plans or as described in schedules, corridor dampers meeting or exceeding the following specification:

C. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel and shall be low profile high performance type for lowest pressure drop. The blades shall be single skin galvanized steel 16 gauge minimum with three longitudinal grooves for reinforcement. Bearings shall be stainless steel turning in an extruded hole in frame. (Galvanized or synthetic bearings shall not be acceptable.) Blade edge seals shall be inflatable silicone coated fiberglass material to insure tight seal and low leakage. Seals shall be mechanically locked into blade edge (adhesive or clip fastened seals not acceptable) and shall withstand a minimum of 450°F. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

D. Each damper shall be listed as a fire damper and leakage (smoke) damper and classified by Underwriters Laboratories as a "Corridor Damper" for installation in tunnel corridors. They shall be rated for 1 hour fire resistance under UL555 and shall have a minimum leakage rating of Class II under UL555S for use in smoke control systems. Each damper shall bear a UL label designating the damper as "Corridor Damper."

E. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 24v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators.

F. Damper manufacturer shall provide factory assembled minimum 20 gauge steel sleeve. Damper shall be sealed to the sleeve with a 25/50 flame spread/smoke developed sealant material.

G. Each corridor damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be automatic remote resettable after test, smoke detection or power failure conditions. After exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1 hour dampers shall be Ruskin model FSD36C or equivalent.

H. Where tunnel corridors use round neck diffusers, furnish and install round combination fire/smoke dampers for ceiling penetration of tunnel corridors complete with integral surface mounted ceiling diffusers, Ruskin model DFSDR or equivalent. Operation shall be the same as described above.

## 2.12 FIRE/SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS) (All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, combination fire/smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each combination fire/smoke damper shall be classified 1-1/2 hour for use in fire resistance ratings of less than 3 hours or 3 hour for use for fire resistance ratings of 3 hours or more. They shall be in accordance with UL standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 24v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of at least 17" long (contractor to verify maximum requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge for dampers above 84" wide. 12" or 22" single piece picture frame mounting angles shall be factory supplied and shipped on each damper/sleeve assembly. Factory shall supply sleeves to accommodate square, rectangular, round, or oval ducts.

E. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be manually resettable after activation by heat and after exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1-1/2 hour dampers shall be Ruskin model FSD60 or equivalent and 3 hour dampers shall be Ruskin model FSD60-3 or equivalent.

F. Smoke control dampers require end switch to prove damper position and method of power monitoring and alarm if no power. All smoke control dampers to achieve their desired state within 75 seconds of the start of the smoke control panel. All smoke control components to be on emergency power.

## 2.13 GRAVITY BACKDRAFT DAMPERS (LOW VELOCITY COUNTERBALANCE TYPE) (< 2.0" w.c.)

A. Acceptable Manufacturers: Air Balance, American Warming, Arrow United (Type 655), Louvers and Dampers Inc., Prefco, Ruskin (CBD4 or CBD6), C.E. Sparrow, Airstream, Greenheck, Pottorff.

B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

## 2.14 BACKDRAFT DAMPERS (HIGH PRESSURE COUNTERBALANCE TYPE) (> 2.0" w.c.)

A. Manufacturer: Arrow United Industries Arrow-Foil Type 800, Greenheck, Ruskin, Pottorff.

B. Extra heavy duty design with air foil extruded aluminum blades with 12 gauge walls, reinforcing struts, double seal type bearings on asymmetrically placed axles with linkage out of the air stream.

C. Dampers engineered for minimum air leakage at high static pressure by means of overlapping design and extruded vinyl seals on blades and jambs.

D. Counterweights located internally on blades externally on extended shaft, adjustable to assist or resist opening at infinite pressure increments.

E. Dampers shall be furnished for horizontal <vertical up> <vertical down> airflow <as indicated on Drawings.

## 2.15 INSULATED FLEXIBLE ROUND DUCTWORK

A. Manufacturer: Flexmaster Type 5B - Insulated.

B. Other acceptable manufacturers offering equivalent product subject to compliance with specified requirements: Genflex, Thermaflex, Wiremold, Cleva-Flex, H.K. Porter Co., Cal-Flex, Hart & Cooley, Hercules - Quietflex.

C. Insulated low pressure flexible duct factory fabricated assembly consisting of a coated fiberglass fabric mechanically interlocked by a corrosion resistant metal spiral helix wrapped with nominal 1 inch thick fiberglass insulation sheathed in a vapor barrier jacket.

D. Composite assembly, including insulation and vapor barrier shall be UL Listed 181 for Class 1 Air Duct Material and comply with NFPA Standard 90A.

E. Accessories: Spin collar fittings with adjustable damper including positive locking regulator damper hardware.

## 2.16 FLEXIBLE DUCT FAN CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Indoor: UL listed fire-resistant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

C. Outdoor: UL listed hypalon coated woven glass fabric to NFPA 90A, minimum density 24 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

D. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs, per sq. ft., 10 dB attenuation in 10 to 10,000 Hz range.

## 2.17 ACCESS DOOR HARDWARE

A. Manufacturer: Ventfabrics Ventlok Series

B. Other acceptable manufacturers offering equivalent product: Duro Dyne.

C. Latches, hinges and gasketing:

Doors less than 4 square feet - Series 100.
Doors 4 to 8 square feet - Series 200.
Larger doors and in medium pressure systems - Series 300.

## 2.18 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

## 2.19 PRESSURE RELIEF DOORS

A. Furnish and install in accordance with the following schedule, pressure relief doors that meet the following minimum specifications. Frames shall be Z-shape 12 gauge (2.8) galvanized steel. Door shall be 12 gauge (2.8) galvanized steel hinged on one side. Seal shall be around the door perimeter allowing no more than 7 CFM per square foot at 1.0 inch w.g. Leakage and relief volume information must be included in submittals. Door shall include stainless steel springs to close door upon pressure relief and system shutdown. Pressure relief settings available from 3" to 10" increments of 1" w.g. Pressure relief mechanism shall be factory calibrated in an AMCA Registered Laboratory. Pressure relief doors shall be Ruskin PRD18, Greenheck, Kees, or Pottorff.

B. Provide the following number of pressure relief doors in the interior septum wall that separates the fan inlet plenum and fan discharge plenum of the built-up fan system.

| System Volume | Number of 18" x 18" Doors Required |
|---|---|
| 0 - 13,000 CFM | 1 |
| 13,100 CFM - 26,000 CFM | 2 |
| 26,100 CFM - 39,000 CFM | 3 |
| 39,100 CFM - 52,000 CFM | 4 |
| 52,100 CFM - 65,000 CFM | 5 |
| 65,100 CFM - 78,000 CFM | 6 |
| 78,100 CFM - 91,000 CFM | 7 |
| 91,100 CFM - 104,000 CFM | 8 |
| 104,100 CFM - 117,000 CFM | 9 |
| 117,100 CFM - 130,000 CFM | 10 |
| 130,100 CFM - 143,000 CFM | 11 |
| 143,100 CFM - 156,000 CFM | 12 |
| 156,100 CFM - 169,000 CFM | 13 |
| 169,100 CFM - 182,000 CFM | 14 |
| 182,100 CFM - 195,000 CFM | 15 |
| 195,100 CFM - 208,000 CFM | 16 |

C. Provide factory mounted end switch to remotely signal when pressure relief doors are fully closed.

## 2.20 AIRFLOW MEASURING DEVICES

A. Manufacturers: Cambridge Air Sentinel, Air Monitor Corp, Ruskin, Ebtron.

B. Each airflow measuring station shall measure airflow by the pitot tube traverse method. Each unit shall consist of a network of static and total pressure sensors factory positioned and connected in parallel to produce an equalized velocity pressure. The measured velocity pressure converted to air flow (cfm) shall have an accuracy within 2% of the full scale throughout the velocity range from 700 to 4000 fpm.

C. Each airflow measuring station shall consist of 16 gauge sheet metal casing, an aluminum air velocity treatment and air straightening section with an open face area of not less than 97%, and a total and static pressure copper sensing manifold. Each station shall contain non-combustible sensors which shall be incapable of producing toxic gases or fumes in the event of elevated duct temperatures. All interconnecting tubing shall be internal to the unit with the exception of one total pressure and one static pressure meter connection.

D. Provide airflow measurement device in all outdoor air intakes tie into BMS system to monitor and alarm.

## 2.21 PLENUM AIR BLENDERS

A. Manufacturer: R.M. Products Air Blenders, Denver, CO

B. Units of the type, size, pressure drop and capacity as scheduled and shown on Drawings.

C. All units factory built and factory tested, and installed in strict accordance with manufacturer's recommendations and as shown on Drawings.

D. Standard fabrication of heavy gauge aluminum all welded construction, completely fixed devices capable of providing air temperature within 6 degrees F of theoretical mixed air temperature.

E. Air blenders located on discharge side of fans in blow-thru type systems shall also function as pressure plates in maintaining even velocities over entire face of coils.

# PART 3 - EXECUTION

## 3.1 GENERAL SHEET METAL INSTALLATION

A. Duct sizes fall within the limiting dimensions indicated on the Drawings. Provide sheet metal duct systems, connections, dampers, duct turns, housings, hinged sheet metal doors and necessary removable access doors for the complete supply, return, and exhaust systems. Install accessories in accordance with manufacturer's instructions.

B. Seal low and medium pressure ductwork per IECC and SMACNA HVAC Air Duct Leakage Test Manual to Seal Class A. This includes all joints, seams, longitudinal, wall penetrations and transverse joints.

C. Wherever exposed ducts pass through walls, floors, or ceilings, a 2-inch flanged sheet-metal collar fitting close around ducts to be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Lock collar to duct.

D. Wherever ducts penetrate floors or fire walls, install safing insulation to maintain fire wall integrity.

E. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

F. Provide openings in ductwork where required to accommodate thermometers and controllers.

G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

H. Where Bellmouth fittings are specifically called for on Drawings, provide standard Bellmouth fittings per SMACNA Standards.

I. Conduct a leakage test, per Chapter 9 of the 2009 IBC, on smoke management system ducts to 1.5 times the design pressure. Total leakage shall not exceed 5% of design flow.

J. Wherever dampers are concealed under insulation, provide marker ribbon for identification. Hang ribbon below adjacent ductwork to allow view from any angle.

## 3.2 MEDIUM AND HIGH PRESSURE DUCTWORK (2" w.c. or greater)

A. Do not use air turns on medium or high pressure ductwork except when duct width exceeds 18", install full length vanes per SMACNA spacing recommendations and where specifically called out on Drawings. Use radius elbows with centerline radius of 1.5D (or 1.5W for rectangular) for all turns in medium pressure ductwork.

## 3.3 SEALING OF DUCTWORK

A. Seal all ductwork to Seal Class A per SMACNA HVAC Duct Construction Standards and the most current edition of the International Energy Conservation Code (IECC). Round runouts to VAV boxes need not be tested but require sealing to Seal Class A when installed. Additional sealing of these runouts will be required if audible air leaks are observed by the Engineer. Where joints are not accessible for proper sealing, cut hand holes in duct and seal the joints from the inside.

B. Conduct a complete duct leakage test as outlined in the most current edition of the SMACNA Air Duct Leakage Test Manual. Unless specifically noted otherwise on Drawings, testing for medium pressure ductwork upstream of VAV boxes is defined as Leakage Class 6 for rectangular ductwork and Leakage Class 3 for round or oval ductwork. Low pressure supply air ductwork downstream of VAV boxes and return air or general exhaust air ductwork is defined as Leakage Class 24 for rectangular ductwork and Leakage Class 12 for round or oval ductwork.

C. Total leakage of each duct system not to exceed recommendations in SMACNA Air Duct Leakage Test Manual per Leakage Classifications defined above. Contractor shall leak test a minimum of 15% of the medium pressure ductwork. If leakage rate exceeds maximum allowed, reseal ductwork until measured system leakage rate is less than the maximum allowable leakage rate.

## 3.4 MANUFACTURED DUCT JOINTS

A. The installation of the manufactured duct joints shall be in accordance with the manufacturer's printed instruction and installation manuals. Apply multiple thicknesses of butyl gasket material at each corner of rectangular duct joints to assure air tightness.

## 3.5 KITCHEN HOOD EXHAUST DUCTWORK

A. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed. Provide cleanouts and slope per code requirements.

B. Seal aluminum dishwasher exhaust ductwork watertight and slope back to dishwasher hood.

## 3.6 DUCTWORK APPLICATION SCHEDULE

A. AIR SYSTEM MATERIAL

| | |
|---|---|
| Low Pressure Supply (Heating Systems) | Galv. Steel, Aluminum |
| Low Pressure Supply (System with cooling coils) | Galv. Steel, Aluminum |
| Medium and High Pressure Supply | Galv. Steel |
| Return and Relief | Galv. Steel, Aluminum |
| General Exhaust | Galv. Steel, Aluminum |
| Kitchen Hood Exhaust | Carbon Steel, Stainless Steel |
| Medium and High Pressure Flex Duct. | Insulated Triple Lock Aluminum |
| Low Pressure Flex Duct | Insulated Flexible Round Duct |
| Dishwasher Exhaust | Stainless Steel, Aluminum |
| Shower and Locker Room Exhaust | Aluminum |
| Outside Air Intake | Galv. Steel |
| Combustion Air | Galv. Steel |

## 3.7 DAMPER OPERATOR HARDWARE

A. Install per manufacturer’s instructions and recommendations. Coordinate any ceiling control locations prior to installation.

B. Coordinate length of flexible shaft on site.

## 3.8 VOLUME CONTROL DAMPERS

A. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.

## 3.9 FIRE DAMPERS, SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

A. Provide fire dampers, combination fire and smoke dampers or smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per manufacturer's instructions.

B. Demonstrate re-setting of fire/smoke dampers and/or smoke dampers to authorities having jurisdiction and Owner's representative.

## 3.10 GRAVITY BACKDRAFT DAMPERS (LOW PRESSURE SYSTEMS)

A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside of building and where indicated.

B. Provide counter-balanced gravity backdraft dampers in return air duct sections from CRAC units to ceiling plenums to prevent air bypass from raised floor to ceiling space when CRAC unit fan is “off”.

## 3.11 MOTORIZED BACKDRAFT DAMPERS

A. Provide motorized backdraft dampers where shown on drawings.

## 3.12 INSULATED FLEXIBLE ROUND DUCTWORK

A. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum length of flexible duct. Hold in place with strap or clamp.

B. Install flexible ducts in a fully extended condition, free of sags and kinks, using only the minimum length required to make the connection.

C. Where horizontal supports are required, suspend flexible duct on 35-inch centers with a minimum 3/4 inch wide flat bending material. Make all joints and connections with 1/2 inch wide positive locking steel straps.

D. Where "lift-out" ceilings occur, install with volume damper in flex duct at connection to main duct.

## 3.13 FLEXIBLE DUCT FAN CONNECTIONS

A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.

B. At least 1-inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to duct work. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

## 3.14 DUCT ACCESS DOORS

A. Provide duct access doors for inspection, maintenance and cleaning at all automatic dampers, flow station, humidifiers, fire and smoke dampers and duct turning vanes and before and after all booster coils.

B. Provide maximum 8 x 8 inch size for hand access, 24 x 24 inch size for shoulder access and as indicated.

C. Provide observation windows to see all automatic modulating dampers and fire and smoke dampers. Access doors in ducts from rated shafts to be from outside the shaft enclosure.

## 3.15 PRESSURE RELIEF DOORS

A. Provide pressure relief doors in accordance with manufacturer's recommendations in plenum wall between suction and discharge of plenum fans to prevent duct or plenum collapse upon failure of high pressure limit controls.

## 3.16 AIRFLOW MEASURING DEVICES

A. Provide airflow measuring devices where indicated in accordance with manufacturer's recommendations.

B. Coordinate control connections with Contractor for Section 230900 - Electronic Controls.

## 3.17 PLENUM AIR BLENDERS

A. Provide factory built air blenders in plenums as indicate on Drawings in strict accordance with manufacturer's recommendations.

**END OF SECTION**

# SECTION 23 3400

# AIR HANDLING FANS

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Cabinet Fans
B. Exhaust Fans
C. Centrifugal Fans
D. In-Line Centrifugal Fans
E. Power Roof Ventilators
F. Exhaust Fans (Ceiling Type)

### 1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

1. Section 230500 - Basic Mechanical Requirements.
2. Section 230529 - Basic Mechanical Materials and Methods.
3. Section 230540 - Mechanical Sound and Vibration Control.
4. Section 230548 - Mechanical Seismic Control.
5. Section 230593 - Testing, Adjusting and Balancing.

### 1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified fans with characteristics, sizes, and capacities required, whose specified fan has been in satisfactory use in similar service for not less than 3 years.

### 1.4 SUBMITTALS

A. Submit shop drawings and product data for the following items under provisions of the General Conditions of the Contract:

1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details for each fan.
2. Product Data: Submit manufacturer's technical product data for all fans showing dimensions, weights, capacities, ratings, fan performance curves with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials. Provide multiple-speed performance curves for fans with variable speed drives.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. All fans.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

## 1.6 EXTRA STOCK

A. Provide one spare set of belts for each belt-driven fan.

# PART 2 - PRODUCTS

## 2.1 CABINET FANS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide cabinet fan of one of the following: Loren Cook, Greenheck, Twin City, Trane, New York Blower, ACME, Peerless, Barry, Penn, Carnes, Soler and Palau, Breidert.

B. Furnish and install cabinet fans of size and capacity shown on drawings.

C. Cabinet shall be constructed of steel with removable panels for access to all internal parts.

D. Fan shall be double width, double inlet multi-blade centrifugal type with V-belt drive and adjustable speed sheave.

E. Fans shall be statically and dynamically balanced and shall run on permanently lubricated bearings.

F. Motor shall be provided per requirements of "Motors" in Section 230529.

## 2.2 CENTRIFUGAL FANS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide centrifugal fan of one of the following: Twin City, Trane, New York Blower, Pace, ACME, Cook, Barry, Carnes, Soler and Palau, Breidert.

B. Type: The fans to be backward inclined, air-foil type completely assembled with fan, fan scroll, motor, belt, drive, belt guard and motor mount, capacity and arrangement as shown on the Drawings, and certified performance tests by Air Moving and Conditioning Association (AMCA) to be submitted with the shop drawing.

C. Housing: To be constructed of steel sheet and parts to be bonderized and then coated with baked primer-finisher. The fan scroll to be attached to the side plates by means of continuous lock seam or welded seam construction.

D. Bearings: The bearings to be of the heavy-duty lubricatible type especially constructed for quiet operation, of the self-aligning, grease pack pillow block type, rated for 200,000 hours of average life.

E. Motor and Drive: To be belt driven with adjustable motor sheave. Motor nameplate horsepower shall exceed brake horsepower by a minimum of five percent. Belts to be of the oil resistant type. Motor to be especially designed for quiet operation and in accordance with "Motors" in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

## 2.3 POWER ROOF VENTILATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide Power Roof Ventilator of one of the following: ACME, Jenn-Air, Penn, Greenheck, Cook, Powerline, Carnes, Twin City Fans, Soler and Palau, Breidert.

B. Furnish and install Power Roof Ventilators of model, size and capacity as shown on Drawings.

C. Housings shall be of contour, type, and material as shown on drawings.

D. Fan: Shall be the backwardly inclined type with centrifugal wheel that has been statically and dynamically balanced at the factory.

E. Motor: Shall be installed in a totally enclosed weatherproof housing outside of the air stream and in accordance with "Motors" in Section 230529.

F. Drive: Units shall be belt driven. Belt shall be oil resistant. An adjustable sheave on the motor shall be provided to allow changes in the fan speed.

G. Installation: Ventilators shall be installed on the roof on a nominal 12-inch high, pre-fabricated, self-flashing aluminum curb with 2" fiberglass insulation and metal liner, furnished with the fan.

H. Disconnect Switch: A factory wired non-fused disconnect switch shall be located under the hood of the unit.

I. Backdraft Dampers: Shall be installed on the curb of the unit unless specifically shown otherwise on the Drawings.

J. Bird Screen: Entire air outlet of the fan shall be protected by a 1/2" x 1/2" aluminum mesh securely installed in place.

K. Kitchen Exhaust Fans: In addition to the above requirements, provide kitchen exhaust fans U.L. listed for grease removal. Provide drain connection and grease trap, external disconnect switch, and curb extension.

## 2.4 EXHAUST FANS (CEILING TYPE)

A. Acceptable Manufacturer: Subject to compliance with requirements, provide ceiling type exhaust fan of one of the following: Penn Co. (Zephyr Model), ILG, Pace, Cook, Jenn-Air, Greenheck, ACME, Carnes, Twin City Fan, Broan, Soler and Palau.

B. Type: Shall be of the centrifugal fan, integral grille and housing type, all completely self-contained.

C. Capacity: Capacity and model number of the units shall be as shown on drawings, and shall be certified by AMCA.

D. Motor and Drive: Fan shall be of the direct drive type, and maximum fan motor speed shall be 1150 RPM. Motor shall be of the permanently lubricated ball bearing type, with built-in impedance or thermal overload protection, and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service. Direct drive fans to include solid state speed controllers.

E. Housing: Shall be constructed of heavy gauge steel, and shall be completely insulated internally with acoustical insulation material to deaden sound.

F. Backdraft Damper: Each fan shall be equipped with a nonmetallic backdraft damper constructed of neoprene and shall be shatterproof under all conditions.

G. U.L. Label: Each fan shall be approved by the Underwriters' Laboratories, Inc. and shall carry the U.L. Label.

H. Intake Grille: Shall be constructed of steel frame and woven steel grille with a minimum free area of 85%. Intake grille shall have a white, factory baked enamel finish.

# PART 3 – EXECUTION

## 3.1 INSTALLATION OF FANS

A. Install fans where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.

D. Do not operate fans for any other purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

E. Support: Install floor-mounted fans on 4" high reinforced concrete pad, 6" larger on each side than unit base in accordance with Section 230529.

F. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 230540.

G. Seismic Restraint: Provide seismic restraints in accordance with Section 230548.

H. 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. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

I. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

## 3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, 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.

## 3.3 EXTRA BELTS

A. Deliver one spare set of belts for each belt-driven fan unit, obtain receipt from Owner that belts have been received.

**END OF SECTION**

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# SECTION 23 3600

# AIR TERMINAL UNITS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. VAV Single Duct Terminal Units.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

### 1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230900 - Electronic Controls.

C. Section 230593 – Testing, Adjusting, and Balancing

### 1.4 SUBMITTALS

A. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. VAV boxes.
2. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation.
3. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch wg.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500.

1. VAV boxes.

## PART 2 - PRODUCTS

### 2.1 VAV LOW PRESSURE ZONE TERMINAL UNITS

A. Manufacturers: Titus Model ESV, Carnes, Krueger, Price, Metal Air, Carrier, Tuttle & Bailey, Anemostat.

B. Terminal units designated of sizes shown on Drawings or terminal unit schedule. Units shall have factory catalog performance ratings which conform to cfm, static pressure, discharge and radiated sound power and attenuation designated.

C. Construction:

1. Cabinets constructed of zinc-coated steel. Casing fabricated to prevent air leakage of no more than 2% of rated air quantity at 1/2" pressure. Internal surfaces acoustically and thermally insulated with 1" glass fiber material surface treated to prevent erosion and having UL approval meeting NBFU and NFPA-90, ASTM C 1071, and ASTM E 84.
2. Air volume damper assemblies made from exactly dimensioned extruded anodized aluminum components. Damper blades shall have extruded ribs which key into grooved shaft for permanent fix of damper. All internal damper pivot points nylon fitted for noiseless operation requiring no lubrication. Damper assemblies constructed to prevent air leakage in excess of 2% of design airflow at 3-inch w.g. at 1" inlet static pressure.
3. Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1000 Pa); and shall have a multipoint velocity sensor at air inlet.

D. Performance Testing and Rating:

1. Performance of units shall be rated in accordance with Industry Standard 880-94.

E. Controls:

1. Controls shall be electronic type as specified in Section 230900. Electric and electronic control devices shall be contained in a NEMA-1 enclosure with access panel sealed from airflow and mounted on side of VAV box.
2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes.

F. Hot Water Coils:

1. Provide, where indicated, terminal units with factory mounted one or two row coils as indicated on schedules. Coils to be aluminum finned hot water heating coils of sizes and capacities indicated on drawings.
2. Coils to be installed so that supply water enters at the bottom and back of coil, rotate coil to accommodate. Improperly installed coils will be reinstalled at Contractor’s expense.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide ceiling access doors or locate above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Connect to ductwork in accordance with Section 233300. Allow minimum 2.5 times duct diameter of straight hard duct at terminal inlet.

## 3.2 ADJUSTING VAV TERMINAL UNITS

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum flow rates per VAV box schedule.

**END OF SECTION**

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# SECTION 23 3713

# AIR INLETS AND OUTLETS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Diffusers.

B. Registers.

C. Grilles.

D. Louvers.

E. Gravity roof hoods.

F. Goosenecks.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500- Basic Mechanical Requirements.

### 1.3 RELATED SECTIONS

A. Section 230500 - Basic Mechanical Materials and Methods: Painting of ductwork visible behind outlets and inlets.

B. Section 233300 - Ductwork and Accessories.

C. Section 233600 - Air Terminal Units.

D. Section 230593 - Testing, Adjusting and Balancing.

### 1.4 REFERENCES

A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

C. ARI 890-91 - Rating of Air Diffusers.

D. ASHRAE 70 - Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard.

F. ASTM C 636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

## 1.5 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70 and ARI 890.

B. Test and rate performance of louvers in accordance with AMCA 500.

## 1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

## 1.7 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated louvers.
2. Shop fabricated roof hoods.
3. Goosenecks.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Diffusers.
2. Registers.
3. Grilles.
4. Louvers.
5. Roof hoods.

C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.

1. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

# PART 2 - PRODUCTS

## 2.1 CEILING DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tempo, Air Diffusion Products, Tuttle & Bailey, TurboX, Price, Hart & Cooley.

B. Diffusers are to be UL Listed and Labeled for use in fire resistive ceiling having a 3-hour or less rating.

## 2.2 CEILING REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tuttle & Bailey, Price, Hart & Cooley.

## 2.3 CEILING SLOT DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Anemostat, Metal-Aire, Nailor-Hart, Carrier, Tempmaster, Tempo, Krueger, Tuttle & Bailey.

## 2.4 WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Metal-Aire, Barber-Colman, Anemostat, Krueger, Tuttle & Bailey, Air Concepts, Price.

## 2.5 LOUVERS

A. Acceptable Manufacturers: Dowco, Airstream, Louvers and Dampers, Inc., Ruskin, Krueger, Air Balance, American Warming and Ventilating, Arrow, C. E. Sparrow, Greenheck, Cesco, Pottorff, Air-Rite.

B. Provide 6 inch deep louvers with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

C. Fabricate of 16 gauge galvanized steel or 12 gauge extruded aluminum, welded assembly, with factory baked enamel finish.

D. Furnish without flange for installation.

## 2.6 GRAVITY ROOF HOODS

A. Acceptable Manufacturers: Acme, Louvers and Dampers, Inc., Penn Ventilator, Greenheck, Ruskin, Cook.

B. Fabricate air inlet or exhaust hoods in accordance with SMACNA Low Pressure Duct Construction Standards.

C. Fabricate of galvanized steel, minimum 16 gauge base and 20 gauge hood, or aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory baked enamel finish.

D. Provide minimum 12 inch high insulated curb base.

E. Make hood outlet area minimum of twice throat area.

## 2.7 GOOSENECKS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards of minimum 18 gauge galvanized steel.

B. Mount on minimum 12 inch high curb base.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Install ceiling mounted items in accordance with ASTM C 636.

1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Install diffusers to ductwork with air tight connection.

G. Install duct connections to fire rated UL Listed and Labeled diffusers and return grilles in strict accordance with instructions furnished by manufacturer.

**END OF SECTION**

# SECTION 23 4100

# AIR CLEANING

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Disposable, extended area panel filters.

B. Extended surface high efficiency media filters.

C. Filter frames.

D. Filter gauges.

### 1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements

### 1.3 RELATED SECTIONS

A. Section 235700 - Heat Transfer.

B. Section 237410 - Air Handling Unit With Coils.

### 1.4 REFERENCES

A. ANSI/UL 900 - Test Performance of Air Filter Units.

B. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods.

### 1.5 QUALITY ASSURANCE

A. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2, as approved by local authorities.

B. Provide all filters as product of one manufacturer.

C. Assemble filter components to form filter banks from products of one manufacturer.

## 1.6 SUBMITTALS

A. Submit Product Data under provisions of The General Conditions of the Contract on filter media, filter performance data, filter assembly and filter frames.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Include instructions for operation, changing, and periodic cleaning.

## 1.7 EXTRA STOCK

A. Provide one extra set of disposable panel filters under provisions of Section 017300.

# PART 2 - PRODUCTS

## 2.1 DISPOSABLE PANEL FILTERS

A. Acceptable Manufacturers: Cambridge, Continental, Camfil, Farr, American Air Filter, ULOK Fiberbond, Flanders.

B. Media: One inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.

C. Rating: 500 FPM face velocity, 0.10 inch WG initial resistance, 0.50 inches WG recommended final resistance.

D. Casing: Cardboard frame with perforated metal retainer.

E. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

## 2.2 DISPOSABLE EXTENDED AREA PANEL FILTERS

A. Acceptable Manufacturers: Cambridge, Camfil, Farr, ULOK Fiberbond, Eco Air, Flanders.

B. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; nominal size 24 x 24 inches x 2 inches.

C. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; 500 FPM face velocity, 0.30 inch WG initial resistance, 1.0 inch WG recommended final resistance.

## 2.3 FILTER FRAMES

A. General: Fabricate filter frames and supporting structures of 16 gauge galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 x 24 inches filter media, minimum 2 inches thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

C. Side Servicing Housings: Flanged for insertion into ductwork, or reinforced 16 gauge galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.

## 2.4 FILTER GAUGES

A. Direct Reading Dial: 4-3/4 inch OD diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-1.0 inch WG, 2 percent of full scale accuracy; Magnehelic Series 2000 manufactured by Dwyer.

B. Inclined Manometer: One piece molded gray plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3 inch WG, 3 percent of full scale accuracy; Model Mark II manufactured by Dwyer.

C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.

D. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

**END OF SECTION**

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# SECTION 23 5700

# HEAT TRANSFER

## PART 1 - GENERAL

### 1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 - Electronic Controls
Section 232113 - HVAC Piping and Specialties
Section 232123 - HVAC Pumps
Section 233400 - Air Handling Fans
Section 236400 - Refrigeration
Section 237410 - Air Handling Unit with Coils

### 1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. All contactors, relays, terminal boxes, thermostats and other electrical appurtenances for electric heat in accordance with "ELECTRIC WIRING" paragraph in Section 230529 - Basic Mechanical Materials and Methods.
2. Cabinet Unit Heaters
3. Fan Coil Units

### 1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

### 1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

## 1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Fan Coil Units
2. Cabinet Unit Heaters
3. Electric Heating Equipment

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500:

1. Fan Coil Units
2. Cabinet Unit Heaters
3. Electric Heating Equipment

# PART 2 - PRODUCTS

## 2.1 ELECTRIC CABINET HEATERS AND UNIT HEATERS

A. Acceptable Manufacturers: Chromalox, Indeeco, Modine, Electromode, Sterling, Raywall, Markel, QMark.

B. Provide electric cabinet heaters and unit heaters of size and capacity as shown on Drawings.

C. Unit Cabinet: Shall be 14 gauge steel, enameled cabinet, color as selected by Architect, adjustable discharge louvers.

D. Motor and Blower Fans: Direct drive, blow-through design, two-speed motors and switch, resilient mounted. Motor and blower to be easily accessible for servicing. Bearings to be factory lubricated.

E. Electric Heating Elements: Fin-tube with helical fins with overheat protection. Unit to be furnished with thermostat for remote mounting as shown on drawings, tamperproof. Provide all contactors, relays, etc., as required. Entire unit to be U.L. approved.

F. Units to be provided with a summer-winter switch to allow operation without heat when desired. Operation as follows: Fan to be cycled by remote thermostat to maintain space temperature. Provide delay switch to keep fan from operating on call for heat until heating elements have warmed up.

## 2.2 CABINET UNIT HEATERS

A. Acceptable Manufacturers: Dunham-Bush, Modine, Carrier, Trane, A.A.F., KHD Co., Airtherm, ITT-Nesbitt, York, McQuay, Sterling, Beacon Morris, Vulcan Inc., First Co., Rittling.

B. Type: Cabinet heaters shall be of the blow-thru cabinet type with hot water heating coil, capacities and model number as shown on the drawings.

C. Arrangement: Arrangement and cabinet type shall be as shown on the drawings.

D. Cabinet: Shall be constructed of 16 - gauge furniture grade steel. Metal surfaces shall be cleaned, phosphatized, prime coated, and all exposed surfaces shall be finished in a baked enamel, color to be selected by Architect. Units on white ceilings shall be white, baked-enamel finish.

E. Fans: Shall be all steel, multi-blade, forward curved, centrifugal-type fan which has been statically and dynamically balanced to eliminate vibration. Fans shall be two-speed direct-drive or driven by V-belt and cast-iron sheaves capable of 25% speed variation. Belts shall be oil and heat resistant.

F. Motor: Shall be of the split-phase, open-type, two-speed, sleeve bearing with resilient mount in the unit. Motor shall be suitable for current characteristics as shown on the drawings, with built-in automatic reset, thermal overload protection. Include all contactors/starters required for automatic operation.

G. Hot Water Heating Coil: Shall be serpentine connected and shall be of the finned copper-tubing type, and shall be hydrostatically tested to twice the working pressure.

H. Filters: Provide 1" thick, disposable filter located in a frame in the return air stream. Filters shall be easily removable by removing front access panel.

I. Control: Unit shall have automatic temperature controls as specified in Section 230900 - Electronic Controls, and shall in addition have internal unit mounted, pre-wired two-speed switch, and "off".

## 2.3 FAN COIL UNITS

A. Acceptable Manufacturers: Carrier, Trane, McQuay, York, Lanco, First Co., Williams, Customair, Sanyo, ETI, Enviro-Tec, Airtherm Inc., Vulcan Inc., Rittling.

B. Units shall consist of coils, drain pan assembly, filter, and centrifugal fan with drive mounted in a common cabinet for independent air delivery from a single unit. Units shall be complete except for controls. All oiling connections shall be extended to exterior of casing to facilitate maintenance without removing sound proofing on exterior of unit.

C. Casings shall be constructed of 16 gauge steel, phosphatized to assure paint adherence and finished with baked enamel. Casings shall be provided with 3/4" glass fiber material meeting NFPA 90A to prevent condensation.

D. Coils shall be of rows shown in schedule. Aluminum fins shall be mechanically bonded to 1/2 inch O.D. seamless copper tubes. All coils shall be specifically designed and circuited for water use. All coils shall be tested at 300 PSI and suitable for working pressures up to 200 PSI.

E. Fans shall be forward curved, centrifugal blower type fans equipped with heavy duty adjustable V-belt drive. The fan shaft shall be supported by a permanently lubricated bearing. All fans shall be dynamically balanced.

F. Drain pans shall be integrally attached to coil casings and are complete with threaded pipe drain connection. All pans shall be galvanized for corrosion resistance and cover the entire coil length. Drain pans shall be waterproofed to prevent leakage.

G. Filters shall be provided on all units. Filters shall be one inch high efficiency throw-away type. Filter access shall be from the side of the unit.

H. Motors shall be as scheduled on the plans. Reference specification Section 230529 for additional requirements.

## PART 3 - EXECUTION

### 3.1 HEAT EXCHANGERS

A. Concrete Bases: Anchor heat exchanger to concrete base.

### 3.2 UNIT HEATERS (HORIZONTAL BLOW)

A. Unless noted otherwise, mount high as possible to give greatest headroom possible. Piping shall be as shown on the plans.

B. Protect the entire unit with a cover during construction.

C. Manufacturers data is to be observed before installation.

### 3.3 CABINET UNIT HEATERS

A. Install in accordance with manufacturers instructions.

B. Provide access to filters, controls, shut-off valves, etc.

### 3.6 FAN COIL UNITS

A. Install in accordance with manufacturers instructions.

B. Provide access to filters, controls, shut-off valves, etc.

C. Route condensate drain to approved receptor.

D. Provide auxiliary drain pan with separate drain line extended to a conspicuous point to serve as an indicator that the primary drain is restricted.

**END OF SECTION**

## SECTION 23 6400

## REFRIGERATION

### PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

B. Refrigerant Piping Materials and Products

### 1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials And Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230700 - Mechanical Insulation
Section 230593 - Testing, Adjusting and Balancing
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps
Section 232500 - HVAC Water Treatment

### 1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Air Conditioning and Refrigeration Institute (ARI):
Standards for the following:

| | |
|---|---|
| # 210/240 - | Unitary Air-Conditioning and Air-Source Heat Pump Equipment |
| # 270 - | Sound Rating of Outdoor Unitary Equipment |
| # 410-72 - | Plate Fin Type Refrigerant Coils |
| # 450 - | Water Cooled Condensers |
| # 460 - | Remote Mechanical-Draft Air Cooled Condensers |
| # 520 - | Positive Displacement Condensing Units |
| # 550/590 - | Water Chilling Packages using the Vapor Compression Cycle |
| # 575 - | Method of Measuring Machinery Sound within an Equipment Space |

2. American National Standards Institute (ANSI):

ANSI B9.1 "Safety Code for Mechanical Refrigeration." (Also known as ANSI/ASHRAE 15).

ANSI B31.5 "Refrigeration Piping," and extend applicable lower pressure limits to pressures below 15 psig.

## 1.4 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

B. The firm installing the refrigeration piping shall have at least 3 years of successful installation experience on projects with refrigeration piping system work similar to that required for this project.

C. Brazing Qualifications: Certify operators, brazing procedures and brazers in accordance with ANSI B31.5 for shop and job-site brazing of refrigerant piping work.

## 1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

B. Certificates: Before proceeding with refrigerant piping work, submit to the Architect/Engineer/Construction Manager/General Contractor two copies of Certification that brazing procedures, brazers and operators will be in accordance with ANSI B31.5.

C. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

# PART 2 - PRODUCTS

## 2.1 CASSETTE-STYLE COOLING-ONLY DUCTLESS DX FAN COIL SPLIT SYSTEMS WITH AIR COOLED CONDENSING UNITS

A. Acceptable Manufacturer: Carrier, Trane, York, Mitsubishi, Daiken, Samsung.

B. Furnish and install factory assembled cooling-only split systems of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.

C. Condensing units shall be of the packaged air cooled type as shown on the Drawings and consist of a rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.

D. The condensing unit shall contain sufficient refrigerant (R134, R410A or R407) for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.

E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.

F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.

G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.

H. Unit to be housed in a fully weatherproof housing made of galvaneal steel, zinc phosphatized, with a baked enamel finish.

I. Condensing unit must be capable of serving DX fan coil located 22 vertical feet below the condenser.

J. Fan coil to be of size and capacity indicated on the drawings. Fan coil to mount on vertical wall surface and have a maximum height of 14”.

K. Fan coil shall be complete with DX cooling coil, condensate pan and drain, direct drive fan, fan motor, filter, piping connectors, microprocessor control system, and integral thermostat. Include integral wall mounting bracket and mounting hardware.

L. Fan coil cabinet to be fully insulated for improved acoustical and thermal performance.

M. Fan coil to be configured with return air drawn in at top of front vertical face, and supply air discharged at bottom of front vertical face. Discharge to include manually adjustable horizontal and vertical deflection blades, as well as automatic motor driven vertical air sweep with on/off switch.

N. Fan coil unit to include a remote control that allows users to turn unit on/off, change setpoints, and change from fan-only to cooling mode.

O. Fan coil to connect to condensing unit for electrical power as necessary.

P. Provide the following accessories:

1. Start capacitor and relay.
2. Indoor fan relay.
3. Liquid line filter drier.
4. Low ambient kit (0°F).
5. Low voltage control transformer.
6. Device to prevent damage to compressor caused by short cycling.
7. Crankcase heater.
8. 14” high roof curb or 4” high concrete if slab on grade.

9. Factory installed starter and disconnect.

## 2.2 REFRIGERANT PIPING MATERIALS AND PRODUCTS

A. General:

1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigeration piping system on maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigeration piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

B. Basic Pipe, Tube and Fittings:

1. Provide pipe, tube and fittings in accordance with the following:

Tube Size 3/4" and Smaller: Copper tube.
Wall Thickness: Type ACR, soft annealed temper.
Fittings: Cast copper-allow for flared copper tubes, ANSI B16.26.
Joints: Flared.
Tube Size 7/8" through 4-1/8": Copper tube.
Wall Thickness: Type ACR, soft annealed temper.
Fittings: Wrought-copper, solder-joints.
Joints: Brazed or soldered.

C. Refrigeration Valves:

1. Globe and Check Valves:

a. Acceptable Manufacturers: Subject to compliance with requirements, provide globe and check valves of one of the following:

Henry Valve Co.
Parker Hannifin Corp., Refrigeration & Air-Conditioning Div.
Sporlan Valve Co.

b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg.F (149 deg.C) temperature rating, 500 psi working pressure.

c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg.F (121 deg.C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

a. Acceptable Manufacturers: Subject to compliance with requirements, provide solenoid valves of one of the following:
Alco Controls Div., Emerson Electric Co.
Automatic Switch Co.
Sporland Valve Co.

b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 115 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg.F (121 deg.C) temperature rating, 400 psi working pressure.

D. Refrigeration Accessories:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

Alco Controls Div., Emerson Electric Co.
Henry Valve Co.
Parker-Hannifin Corp., Refrigeration & Air-Conditioning Div.
Sporlan Valve Co.
Toxalert

2. Refrigerant Strainers: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL listed, 350 psi working pressure.
3. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200 deg.F (93 deg.C) temperature rating, 500 psi working pressure.
4. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.
5. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
6. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL listed.

## PART 3 - EXECUTION

### 3.1 REFRIGERATION EQUIPMENT INSTALLATION

A. General: Comply with manufacturer's recommended installation instructions.

B. Provide sound and vibration isolation in accordance with Section 230540 - Mechanical Sound and Vibration Control.

C. Equipment manufacturer to provide labor to assemble, test, charge, start-up, calibrate, and instruct Owner's personnel in operation and maintenance.

### 3.2 REFRIGERATION SYSTEM INSTALLATION

A. Refrigerant Piping:

1. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Comply with ANSI B31 Code for Pressure Piping.

2. Piping to be kept clean and dry with factory installed caps in place until time of installation. Keep the entire system clean and dry during the installation. Piping to be straight and free of kinks, ripples, or restrictions of any kind. Bending the pipe will not be permitted. Fittings required to be of the long radius pattern except when used for oil traps.
3. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.
4. Pitch refrigerant piping 1" in 15 feet in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.
5. Refrigeration system connections shall be of the sweat copper type properly cleaned and silver brazed with Sil-Fos or Easy-Flor solders using Handy and Harmon flux. Circulate nitrogen through tubes being soldered to eliminate the formation of copper oxide during the brazing operation.
6. Evacuation and leak test shall be made after refrigerant piping system is completed. The Contractor shall draw a vacuum on the entire system with a vacuum pump, the vacuum shall hold for 12 hours at 25 inches hg. of vacuum. The Contractor shall then break the vacuum with clean dry refrigerant, he shall then make a test with halide detector, after which he shall then draw another vacuum down to 25 in. and again break the vacuum with new clean dry refrigerant. The system shall then be fully charged with refrigerant and tested with halide detector at all joints.
7. Solder copper tube-and-fitting joints where indicated using silver-lead solder, ASTM B32, Grade 96 TS, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
8. Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal. Bleed dry nitrogen through refrigerant piping during brazing operations.
9. Provide pipe hangers and supports in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Refrigerant Valves:

1. Provide refrigerant type hand valves where indicated on the Drawings and wherever required for routine servicing. Install in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.
2. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards. Wire in accordance with "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

C. Refrigerant Accessories:

1. Liquid indicators, strainers and filter-drier: Furnish and install in each refrigerant circuit and in accessible location for service.
2. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.
3. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

D. Refrigerant Coils:

1. Mount refrigeration coils as shown on Drawings complete with drain pans and drain piping to floor drains.
2. Provide refrigeration piping with rubber sleeves to prevent vibration transmissions where piping passes thru plenum wall.

E. Equipment Connections:

1. General: Connect refrigerant piping to mechanical equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.
2. Provide flexible connections in suction and discharge lines at compressor and install valves where necessary for proper service and maintenance.
3. The oil level in the compressors to be checked or removed to achieve the correct level. The oil level to be rechecked after extended operation and adjusted accordingly.
4. Install refrigeration equipment on vibration isolation mountings in accordance with Section 230540 - Mechanical Sound and Vibration Control.

F. Dehydration and Charging System:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg.F (2 deg.C) is indicated on vacuum dehydration indicator.
3. Provide manufacturer's recommended refrigerant charge to system to obtain optimum operating conditions.

**END OF SECTION**

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# SECTION 23 7410

# AIR HANDLING UNIT WITH COILS

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Packaged air handling units.

### 1.2 RELATED WORK

A. Requirements: Provide air handling unit with coils in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements

C. Section 230529 - Basic Mechanical Materials and Methods

D. Section 230540 - Mechanical Sound and Vibration Control

E. Section 230548 - Mechanical Seismic Control

F. Section 230900 - Electronic Controls

G. Section 230593 - Testing, Adjusting and Balancing

H. Section 234100 - Air Cleaning

### 1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards: Comply with the following:

1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 300 and 301 for sound ratings.
2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models. Test and rate coils in accordance with ARI 410 – “Standards for Forced Circulation Air-Cooling and Air-Heating Coils”.
3. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
4. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards. Units with factory wiring shall be factory UL or ETL approved and labeled.

5. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.
6. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

C. The following shall be used as selection criteria and shall be as specified: Airflow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, water pressure drops.

## 1.4 SUBMITTALS

A. Submit shop drawings and product data for the following items under provisions of The General Conditions of the Contract:

1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.
2. Product Data: Submit manufacturer's technical product data showing dimensions, weights, capacities, ratings, detailed fan performance curves with operating point clearly indicated, motor ratings and electrical characteristics, sound power levels (inlet, outlet, and radiated), coil ratings, filter data, wiring diagrams, gauges and finishes of materials.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Air Handling Unit

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver air handling units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers. Deliver air handling units with all openings covered with plywood and fiber-reinforced plastic sheeting to protect the units while in transit.

B. Handle air handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

C. Store air handling units in clean place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

## 1.6 EXTRA STOCK

A. Provide one complete extra set of filters for each air handling unit.

B. Provide one spare set of belts for each belt-driven air handling unit.

C. Provide one spare sump pump for each evaporative media sump.

## PART 2 - PRODUCTS

### 2.1 PACKAGED AIR HANDLING UNITS

A. Approved manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Temtrol
2. Governair
3. Haakon
4. Mammoth
5. York
6. Racan
7. Carrier
8. Trane
9. McQuay
10. AAON
11. Energy Labs
12. Unitech

B. Manufactured Units:

1. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, dampers, plenums, filters, drip pans, and mixing box. Provide factory-fabricated and factory-tested air-handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

C. Casing:

1. Walls and roof of each unit shall have a support framework constructed of tubular steel to which all exterior and interior panels are mechanically fastened. All walls shall be constructed of minimum 2 inch thick “double wall” acoustical thermal panels. Exterior wall panels shall be a minimum of 18 gauge G90 galvanized steel. The inner wall shall be a minimum of 22 gauge, perforated G90 galvanized steel. The inner wall where downstream of final filters shall be a minimum of 22 gauge, solid G90 galvanized steel. The insulation shall be 2 inch 1.5 lb/cu ft. density fiberglass. All permanently joined flanged panel surfaces shall be sealed with an individual strip of tape sealer and caulked with a high grade silicone sealant. Wall (and roof) seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit. All panel seams on outdoor units shall be sealed weather tight.
2. All insulation edges shall be protected with metal lagging.
3. Units shall ship as one single piece whenever feasible. If multiple sections are required, the units shall be engineered for simple demount and field assembly. Mating frames of each section shall be fabricated with a flanged perimeter which is predrilled with assembly clearance bolting holes and is continuously gasketed. Demount gasket supplied with the unit shall be a high quality weather resistant closed cell neoprene sponge rubber. Assembly lugs, fabricated from structural steel with appropriate assembly clearance holes shall be welded to the base frame. All gasket and necessary assembly hardware shall ship with the unit sections, boxed separately, and clearly marked.

4. The AHU framework and casing construction shall be fabricated in such a manner as to comply with the following requirements:

   a. Should it become necessary to remove casing panels to facilitate removal, replacement or repair of internal equipment components such as fan wheels, shafts, motors or coils, the unit must be able to be disassembled and supported without the use of external or supplemental bracing. If this is not possible, then access doors must be provided of sufficient size to allow for removal of any components without structural degradation of the unit.

D. Base Construction:

1. Base shall be constructed from a minimum 12 gauge galvanized steel tubes or channels, fitted with cross members to support all interior components. Base shall be provided with lifting lugs, minimum four (4) per unit section.
2. Floor shall be flat, with all seams continuously sealed. Provide safety pipe railing on all floor openings larger than 3 sq.ft.
3. Provide auxiliary drains in fan sections downstream of cooling coils and humidifiers, and in mixing sections. Drain pans shall be 3" deep fabricated of 18 gauge, 304 stainless steel with 1-1/4" MPT connections mounted below the bottom of the drain pan and the subfloor of the unit. Drain pan shall be sloped to the outlet in the pan floor so as to prevent any standing water to accumulate in the drain pan. Stacked coils shall have intermediate drain pans with copper downspouts to the main drain pan. Units without such intermediate drain pans for stacked coils will not be accepted.
4. All drain connections on floor mounted air handling units shall terminate at the side of the unit.

E. Access Doors:

1. Access doors shall be manufactured from 18 gauge G90 galvanized steel. The doors shall be double wall construction with 22 gauge solid metal liner on the inside. Corners of the doors shall be continuously welded for rigidity. One inch 1.5 lb/cu ft. density insulation shall be sandwiched between the outer layer and the inner layer.
2. Two metal latches operable from either side of door shall be provided. Door opening shall be fully gasketed with continuous neoprene/EDPM rubber bulb type gasket rated for a constant exposure temperature range of -20$^{o}$F to 160$^{o}$F. All doors shall swing open against the AHU component section pressure except on outdoor units. Doors shall have door tie backs to secure an open position. Door frames shall be made from 16 gauge galvanized steel or extruded aluminum with the outside of the door flush with the unit. Minimum door opening size shall be 24 in. x 60 in. (where unit height permits). Provide 10” x 10” wire – reinforced glass window in each access door.

F. Fans - Supply:

1. Fans shall be backward inclined DWDI or plug type as indicated in the schedules or as implied by the specified equipment. Fans shall be Class II for 2 in. w.g. s.p. and above.
2. All fans shall be tested in accordance with AMCA Standard 210-70 Test Code for Air Moving Devices.
3. Backward inclined fans shall bear the AMCA sticker. Backward inclined wheels over 22 inches diameter shall have double thickness airfoil shaped fan blades.

4. Fan housing shall be constructed of steel, adequately braced with structural steel for rigidity. Plug fans shall be encased by a protective steel screen.
5. Fan shafts are to be solid, ground and polished, carbon steel, SAE 1045 materials, machined to close tolerances, keyed to the fan wheel. Coat the fan shaft with a rust inhibitor after machining. Hollow shafts will not be acceptable.
6. Fan bearings shall be in self aligning pillow block, grease lubricated, extra heavy duty antifriction ball or spherical roller type, selected for an AFBMA L-50 average life of 200,000 hours at design operating conditions. Bearings are to be mounted on the fan structural bracing. Provide extended lubrication lines to permit lubrication for both bearings to be performed from the access door side of the air handling unit.
7. Fan motors shall be in accordance with Section 230529. Provide variable frequency drive and matched motor, where indicated, in accordance with Section 230810. Provide factory-mounted and wired U.L. listed variable frequency drive and disconnect.
8. Fan and motor are to be mounted on an all welded, structural steel, prime coated, internal isolation base with springs selected to provide 99% isolation efficiency from the building structure. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible fabric connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.
9. Drive sheaves are to be machined cast iron. Provide an adjustable motor sheave on motors of 5 HP and less. Sheave selections and belt lengths are to be in accordance with the drive manufacturer for the specific motor loads being encountered including a 1.5 service factor.
10. Provide a metal belt guard having sides of galvanized steel and expanded metal face with openings for fan tachometer readings. Belt guard shall be sized to allow either sheave to be increased by two sizes. Interlocking door "kill" switch, factory mounted and wired can be furnished in lieu of a belt guard or fan screen.

G. Vibration Isolation:

1. An integral all welded steel vibration isolation base shall be provided for the fan and motor.
2. Seismic certified spring isolators shall be free standing with sound deadening pads and leveling bolts. Spring diameter to compressed operating height ratio shall be 1 to 1. Spring deflection shall be per Section 230540 requirements. Isolators shall have integral seismic restraints. If isolators are not a seismic rated assembly, then the restraint device must be approved and stamped by a licensed engineer duly registered in the state of the project site for this specific job.

H. Electrical:

1. Starters, Electrical Devices, and Wiring: Electrical devices and connections to comply with Division 26.

I. Coils:

1. Coils shall be fully enclosed within casing and mounted on angle iron racks. Cooling coil racks shall be primed with zinc rich chromate primer. Removable coil access panels shall be provided to remove coils through casing wall.
2. Drain pans shall be 18 gauge, 304 stainless steel. Intermediate drain pans shall be interconnected with 1 inch copper drain lines.

3. Coils shall be designed for chilled water or hot water service with 5/8" dia. tubing of 0.035" wall thickness. Maximum fins per inch shall be 11. Coils shall be hydrostatically tested at 400 Psig, and shall be suitable for working pressures and temperatures up to 200 Psig and 220 degrees F. Fin thickness shall be 0.008 inch minimum. Coils must have brazed U-bend return bends. Hairpin construction type coils will not be accepted.
4. Coils shall be certified in accordance with ARI Standard 410.
5. Pipe connections shall be on the same end, and shall be threaded.
6. Water coils shall be fully drainable.
7. Coils indicated as being cleanable shall have either a cleanout plug for each tube or shall have a gasketed removable header cover.
8. Steam face and bypass heating coils shall be non-freeze internal distributing tube type. 1" O.D. outer tube minimum 0.030 inch thick copper with aluminum copper fins. Inner tube shall have orifices designed for even distribution of steam across coil face and discharge in the direction of condensate flow. Headers of cast iron or copper pipe. Design for 100 psig working pressure, leak test to 200 psig.

J. Filters:

1. Rigid Filters: Filters shall be 12" thick, 85% efficient, pleated, disposable type. Each filter shall consist of a non-woven cotton or synthetic fabric media, media support grid, and enclosing frame. Filter shall be U.L. Listed Class 2. Provide 2" prefilters upstream of rigid filters.

K. Filter Gauges:

1. Provide Dwyer 2000 magnehelic gauges factory installed on casing of AHU. Magnehelic gauges shall be accurate to ±2% of full range. Sensing probes and shut-off valves shall be provided for each gauge. One gauge shall be provided for each filter bank.

L. Finish:

1. Unit shall be finished painted with two component etch bond primer and finish painted with alkyd enamel, color as selected by Architect. All uncoated steel shall be painted with red oxide primer. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bond to metal. Bright spangled galvanized finish is acceptable in lieu of painted finish.

M. Lights:

1. Marine lights with protective metal cage shall be installed in all accessible sections on the wall across from the access doors. A lighting switch with an indicator light and duplex receptacle shall be installed on the unit. Electrical power shall be 120/1/60.

N. Dampers:

1. Dampers shall be Ruskin CD60 double skin air foil, or Engineer accepted equal.
2. Position damper parallel blades so that return air and outside air streams are directed toward each other to promote better mixing of the air.
3. Damper actuators to be supplied by the ATC contractor. Specified torque requirements for each damper assembly shall be coordinated with the ATC contractor to ensure a sufficient quantity and size of actuators is used to provide a complete shut-off of the dampers.

O. Electrical Service:

1. The unit shall be have factory installed conduit and wiring to a single point in the field exterior to the AHU casing. All wiring and components shall comply with the current National Electrical Code and Division 26.
2. Provide motor starters, disconnects, transformers and all required accessories complying with Division 26 unless these are specified to be by Division 26 or unless a remotely located VFD is to be used.
3. Units in which the supply and/or return fan is controlled by an external variable frequency drive shall have a separate 120/1/60 circuit for lights and outlets.
4. Unit shall be ETL listed and labeled.

P. Controls:

1. Provide a complete factory-mounted, wired, and programmed DDC control system.
2. Each air handler shall have a separate DDC controller. Each controller shall have a LCD screen and keypad operator's interface.
3. Provide all control devices including control valves and actuators, damper actuators, temperature sensors, pressure sensors, flow sensors, current monitors, low limit thermostats, transformers, cabinets, and etc.
4. Provide complete installation kits and instructions for field-installed devices including space temperature and humidity sensors, duct and space static pressure sensors, and etc.
5. All wiring shall be in accordance with the NEC. Enclose all wiring within unit framing or factory-mounted conduit. Field wiring shall be enclosed in conduit or run in armored cable.
6. Division 23 contractor shall be responsible for installation of field-installed devices and wiring.
7. Air handler controls shall be fully integrated with the building DDC control system provided under Section 230900. Provide all hardware, software, licensing, and programming to allow remote monitoring and control of all available data points and control functions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Install air-handling units level and plumb, in accordance with manufacturer's written instructions and recognized industry practices. Maintain manufacturer's recommended clearances.

1. Unless otherwise noted on the drawings or in Part 2, support floor-mounted units on concrete equipment bases 4" high and 4" larger than equipment base on each side, in accordance with Section 230529. Secure units to anchor bolts installed in concrete equipment base. Provide seismic restraint in accordance with Section 230548.
2. Unless otherwise noted on the drawings or in Part 2, support roof-mounted units on factory-fabricated insulated galvanized steel roof curbs nominal 12" high. Construct with integral slope for mounting on sloped roof. Secure units to roof curb. Provide seismic restraint in accordance with Section 230548.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance. Coordinate installation with the work of other trades.

## 3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
2. Connect condensate drain pans using 1-1/4-inch minimum, Type L copper tubing. Extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

B. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.

C. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 26.
2. Temperature control wiring and interlock wiring is specified in Section 230900 and 230529.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

## 3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of air-handling units including piping, ductwork, and electrical connections.
2. Prepare a written report on findings and make recommended corrective actions.

## 3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.

B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

D. Comb coil fins.

## 3.5 COMMISSIONING

A. Final Checks before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.

2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
10. Disable automatic temperature control operators.

B. Starting procedures for air-handling units:

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

a. Replace fan and/or motor sheaves and belts as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.
3. Verify and adjust sump fill/drain valves to confirm adequacy of installation at full load conditions.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Section 230593 "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

## 3.6 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least 7 days advance notice.

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# DIVISION 25 – INTEGRATED AUTOMATION

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# DIVISION 26 - ELECTRICAL


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| Section 26 0500 | Common Work Results for Electrical |
| Section 26 0500 | Common Work Results for Electrical |
| Section 26 0519 | Low-voltage Electrical Power Conductors and Cables |
| Section 26 0526 | Grounding and Bonding for Electrical Systems |
| Section 26 0529 | Hangers and Supports for Electrical Systems |
| Section 26 0533 | Raceway and Boxes for Electrical Systems |
| Section 26 0548 | Vibration and Seismic Controls for Electrical Systems |
| Section 26 0553 | Identification for Electrical Systems |
| Section 26 0923 | Lighting Control Devices |
| Section 26 2416 | Panelboards |
| Section 26 2726 | Wiring Devices |
| Section 26 2813 | Fuses |
| Section 26 2816 | Enclosed Switches and Circuit Breakers |
| Section 26 5100 | Interior Lighting |

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# SECTION 26 0500

# COMMON WORK RESULTS FOR ELECTRICAL

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Raceways.
5. Grout.
6. Common electrical installation requirements.
7. Concrete equipment bases.
8. Building wire and connectors.
9. Supporting devices for electrical components.
10. Electrical identification.
11. Electricity-metering components.
12. Cutting and patching for electrical construction.
13. Touchup painting.
14. Workmanship.
15. Coordination drawings.
16. Rough-ins.
17. Electrical installations.
18. Cutting and patching.
19. Submittals.
20. Record documents.
21. Maintenance manuals.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. PVC: Polyvinyl chloride.

D. OSHA: Occupational Safety and Health Administration.

E. NFPA: National Fire Protection Association.

F. EPA: Environmental Protection Agency

G. KW: Kilowatts.

H. NECA: National Electrical Contractor Association

I. EMT: Electrical metallic tubing.

J. FMC: Flexible metal conduit.

K. IMC: Intermediate metal conduit.

L. LFMC: Liquidtight flexible metal conduit.

M. RNC: Rigid nonmetallic conduit.

## 1.4 SUBMITTALS

A. Product Data: For sleeve seals.

B. Product Data: Follow the procedure specified in Division 1 Section “Submittals”.

C. Shop Drawings: Dimensioned plans and sections or elevation layouts of electrical-metering equipment.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Additional copies may be required by individual sections of these Specifications.

F. Prepare coordination drawings in accordance with Division 1 Section “Project Coordination”, to a scale of ¼”=1’-0”, or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installation, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work.

## 1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

## 1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
5. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
6. Exterior wall and foundation penetrations.
7. Fire rated wall and floor penetrations.
8. Equipment connections and support details.
9. Sizes and location of required concrete pad and bases.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

D. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

H. Verify voltage, phase and amps of all equipment, prior to rough-in phase of project.

I. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

J. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

K. Indicate the proposed locations of the major raceway systems, equipment and materials. Including the following:
1. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
2. Exterior wall and foundation penetrations.
3. Fire rated wall and floor penetrations.
4. Equipment connections and support details.
5. Sizes and location of required concrete pad and bases.

## 1.7 WORKMANSHIP

A. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by workmen skilled in the type of work involved.

B. The Electrical Contractor shall have a licensed or certified Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed or certified journeyman electrician shall be assigned to supervise the actual performance of all electrical work under Division 26. All installers must be certified journeyman.

1. All workmen doing electrical work of any nature must at all times carry their electrician's license with them and show it upon request.

2. The licensed or certified journeyman assigned to supervise the performance of Division 26 electrical work, shall be required to be on the job site at all times, while Division 26 work is being performed.

C. The installation shall conform to the applicable rules of the National Electrical Code and National Electrical Safety Code except where more stringent requirements are noted in these specifications. Conflicts shall be brought to the attention of the Architect/Engineer.

D. The Contractor and Sub-contractors shall comply with OSHA and EPA Standards while in the performance of this contract.

## 1.8 SUBSTITUTIONS

A. The equipment specified carries brand names and catalog numbers and shall be interpreted as establishing a standard of quality. Use only specified items or those listed by addenda.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the supplier, who shall bear all costs required to make the equipment comply with the intent of the plans and specifications.

C. At the option of the Architect/Engineer, samples may be required for non-standard items before installation during construction.

D. No materials or apparatus shall be substituted after the bid opening except where the equipment manufacturer has been discontinued or delivery becomes a problem, then written approval of the Architect/Engineer is required.

## 1.9 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size, and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

## PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. PVC Pipe Sleeves: Schedule 40, PVC, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: As required to match the specified roof material interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Right of Way: Give to piping systems installed at a required slope.

E. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

## 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

## 3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

## 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 4000-psi, 28-day compressive-strength concrete and reinforcement.

## 3.5 FIRESTOPPING

A. Apply firestopping to penetrations of cable tray, fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

## 3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality at no cost to the owner.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

F. Contractor shall remove lamps and ballasts from the existing light fixtures and dispose them in the owner furnished containers.

## 3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

C. Repair conduit and system that have been disturbed or broken, see 3.6B.

## 3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Raceways.
   2. Building wire and connectors.
   3. Supporting devices for electrical components.
   4. Electrical identification.
   5. Electricity-metering components.
   6. Concrete bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.
   9. Touchup painting.

## 3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

## 3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

**END OF SECTION 26 0500**

# SECTION 26 0519

# LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Division 26 Section “Electrical System Testing” for testing of all conductor and cables installations.

### 1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. NFPA: National Fire Prevention Association

D. ASTM: American Society for Testing and Materials

E. NEMA: National electrical Manufacturers Association

F. NETA: National Educational Telecommunications Association

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

**PART 2 - PRODUCTS**

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 “Conductor Insulation and Multiconductor Cable Applications and Wiring Methods” Article for insulation type, cable construction and ratings.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are allowed on this project.

E. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

F. Minimum Conductor Size (power conductors): #12 AWG

G. MC-Cable or Romex cables shall not be used in this project.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are not allowed on this project.

E. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

F. Minimum Conductor Size (power conductors): #12 AWG.

## 2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138-inch thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.4 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: As required for the specified materials interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded for all conductor sizes, unless otherwise indicated.

B. Branch Circuits: Copper. Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger. All control conductors shall be THHN/THWN stranded in raceway. Motor loads shall be stranded copper..

C. Aluminum conductors are not allowed on this project.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway .

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Fire Alarm Circuits: Type THHN-THWN, in single raceway, unless specified otherwise in Section 28, ”Digital, Addressable Fire Alarm System”.

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

## 3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

H. Clean conduits with a 95% mandrel, prior to installation of conductors.

## 3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

## 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces. (Public Areas)

G. Extend sleeves installed in floors 2 inches above finished floor level. (Utility Areas)

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

## 3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

## 3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

## 3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

2. Prior to energizing, check installed wires and cables with megaohm meter to determine insulation resistance levels to assure requirements are fulfilled.

3. Provide written documents for all Megger testing.

4. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

5. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

D. Refer to "Commissioning Specification" sections for project commissioning requirements.

**END OF SECTION 26 0519**

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# SECTION 26 0526

# GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment., plus the following special applications:
   1. Underground distribution grounding.

B. Related Sections include the following:
   1. Division 2 Section "Underground Ducts and Utility Structures" for ground test wells.

### 1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned locations of proposed grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

### 1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

B. Comply with NFPA 70; for medium-voltage underground construction, comply with IEEE C2.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/Hubbell.

b. Copperweld Corp.
c. Erico Inc.; Electrical Products Group.
d. Framatome Connectors/Burndy Electrical.
e. Harger Lightning Protection, Inc.
f. Heary Brothers Lightning Protection Co.
g. Kearney/Cooper Power Systems.
h. Korns: C. C. Korns Co.; Division of Robroy Industries.
i. Lyncole XIT Grounding.
j. O-Z/Gedney Co.; a business of the EGS Electrical Group.
k. Raco, Inc.; Division of Hubbell.
l. Thomas & Betts, Electrical.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus:
1. Rectangular bars of annealed copper, 1/4 by 2 inches by 14 inches in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Non Reversible Crimps

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions required at the grounding rods.

2.4 GROUNDING ELECTRODES

A. Ground Rods: stainless steel; 3/4 inch by 10 feet in diameter.

**PART 3 - EXECUTION**

3.1 APPLICATIONS

A. Conductors: Stranded for all conductor sizes, unless otherwise indicated.

B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. In raceways, use insulated equipment grounding conductors.

D. Exothermic-Welded Connections: Use for underground connections, except those at test wells.

E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

F. Grounding Bus: Install in all electrical and all telephone equipment rooms, in rooms housing service equipment, under all raised floors and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the doorframe, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use tinned- copper conductor, No. #2 AWG Bare CU minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

H. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum or as shown on the plans.

   1. Bury at least 24 inches below grade.

I. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

   1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

J. Conductor Terminations and Connections:

   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Structural Steel: Non Reversible Crimp.

## 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Coordinate with Drawings and with Division 26 Section "Underground Ducts and Raceways for Electrical Systems.".

C. Pad-Mounted Transformers and Switches: Install two ground rods around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install insulated equipment grounding conductors with all feeders and branch circuits.

C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

D. Computer Outlet Circuits: Install insulated equipment-grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Nonmetallic Raceways: Install an equipment-grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment-grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment-grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

I. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

J. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods:
   1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
   3. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   4. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
   5. Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

   1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

## 3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

## 3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with a 50 percent ampacity of the largest phase conductor in the duct bank. (2) #4/0 AWG Bare CU minimum.

B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

## 3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

**END OF SECTION 26 0526**

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# SECTION 26 0529

# HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

### 1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

### 1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

### 1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

**PART 2 - PRODUCTS**

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 3/4inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

## 3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Support structure width shall be 24 inches (min), unless specified otherwise.

## 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

## 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 26 0529**

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## SECTION 26 0533

## RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

## PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT:
   a. Steel, set-screw type in interior/dry locations.
   b. Utilize steel, compression type in damp or exterior locations.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

## 2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type or As indicated.

E. Finish: Manufacturer's standard enamel finish.

F. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## 2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect/Engineer.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Thomas & Betts Corporation.
      b. Walker Systems, Inc.; Wiremold Company (The).
      c. Wiremold Company (The); Electrical Sales Division.

## 2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

## 2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC, “COMMUNICATION,” or as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Quazite.

## 2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138” thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.8 SLEEVE SEALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried. Conduit bends over 22 deg. must be rigid steel.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Minimum Raceway Size: 1-inch trade size.
7. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer-concrete frame and cover, SCTE 77, Tier 15 structural load rating.
b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.
c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:
1. Minimum Raceway Size: 3/4-inch trade size.
2. Exposed, Not Subject to Physical Damage: EMT.
3. Exposed, Not Subject to Severe Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway or EMT.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway or EMT.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

D. Aluminum conduits are not permitted on project.

## 3.2 INSTALLATION

A. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

J. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory long sweep on medium voltage elbows may be used in banked runs only where they can be installed parallel. This requires raceways be o fht esame size. In other cases provide field bends for parallel raceways.

K. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which no more than two 90-degree bends are allowed.

L. Conceal conduit and EMT within finished walls, ceilings, and below floors, unless otherwise indicated.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
   1. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements. Follow the ANSI/TA/EIA-569-B standards. Conduit to end withing 12 inches of cable tray with a bend toward IDF room. Provide throat type or equal type plastic bushing.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; LFMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

   1. 1-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

S. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

T. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

V. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

W. Set metal floor boxes level and flush with finished floor surface.

X. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.

Y. Tighten set screws of threadless fittings with suitable tools.

Z. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

BB. Run a 95% mandril through each conduit, prior to the installation of conductors.

## 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows at vault entrances, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

## 3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

## 3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

## 3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

## 3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 26 0533**

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## SECTION 26 0548

## VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Coordinate with structural documents.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

a. Component Importance Factor: Per Structural requirement..
b. Component Response Modification Factor: Per Structural requirement..
c. Component Amplification Factor Per Structural requirement..

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): .
4. Design Spectral Response Acceleration at 1.0-Second Period:

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

   a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

**PART 2 - PRODUCTS**

2.1 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.2 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Coordinate products in this Article with structural engineer and with Drawings.

B. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

C. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

D. Concrete Inserts: Steel-channel type.

E. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

F. Welding Lugs: Comply with MSS SP-69, Type 57.

G. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

H. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

## 2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized.
3. Hot-dipped galvanize metal components for exterior use.
4. Corrosive Locations: Stainless Steel.
5. Baked enamel or powder coat for metal components on isolators for interior use.
6. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.4 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

C. STRUCTURAL ATTACHMENTS
1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
3. Attachments to Existing Concrete: Use expansion anchors.
4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
7. Attachments to Wood Structural Members: Install bolts through members.
8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

## 3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

## 3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Testing: Test pull-out resistance of seismic anchorage devices.
   1. Provide necessary test equipment required for reliable testing.
   2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   3. Retain subparagraphs below with any paragraph selected above.
   4. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
   5. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
   6. Edit sampling frequency in subparagraph below to suit Project.
   7. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   8. Test to 90 percent of rated proof load of device.
   9. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
   10. Record test results.

## 3.7 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

## 3.8 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

   1. Equipment Location: as required.
   2. Pads:

      a. Material: Neoprene.
      b. Thickness: ¼ inches.

3. Isolator Type: As designated in Part 2.
4. Component Importance Factor: Per Structural requirement..
5. Component Response Modification Factor: Per Structural requirement..
6. Component Amplification Factor: Per Structural requirement..

**END OF SECTION 26 0548**

# SECTION 26 0553

# IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products, as requested by owner.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

**PART 2 - PRODUCTS**

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less (see 3.1F):

1. Black letters on an orange field.
2. Legend: Indicate system or service and voltage.

C. Colors for Raceways Carrying Circuits at More Than 600 V (see 3.1F):

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## 2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape, not less than 3 mils thick by 1 to 2 inches wide. Conductors in sizes #6 and below shall be color coded with the colored insulation. Larger sizes may be identified with colored tape.

## 2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type ID (warning tape with metal core):

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

## 2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR:"
   a. Working Voltage 208V: 36 inches.
   b. Working Voltage 480V: 48 inches.
   c. Working Voltage 4160V: 60 inches.
   d. Working Voltage 12,470V: 10 feet.
   e. Working Voltage 46,000V: 10 feet.

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.8 CABLE TIES

A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:

      a. Fire-Alarm System: Red.
      b. Fire-Suppression Supervisory and Control System: Red and yellow.
      c. Combined Fire-Alarm and Security System: Red and blue
      d. Security System: Purple
      e. Mechanical and Electrical Supervisory System: Green and blue.
      f. Telecommunications System: Blue
      g. Emergency power system: Yellow.
      h. 277/480 volts system: Brown.
      i. 120/208 volts system: Black.
      j. Clocks & Bells: Orange.
      k. Sound System: Green.
      l. Traveler (switch to light or switch to switch) 120 volts: Pink
      m. Traveler (switch to light or switch to switch) 277 volts: Purple
      n. Lighting control and dimmers systems: White.

G. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench. Extend metal tape cable to inside transformer low voltage enclosure.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

K. Circuit Identification Labels on Boxes: Install labels externally.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.
   3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

## 3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH

VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with color conduit. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral : White
      5) Ground : Green
      6) Isolated Ground: White & Green
      7) Control: Violet
   c. 480/277-V Conductors:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral : Gray
      5) Ground : Green
      6) Isolated Ground: White & Green
      7) Control: Violet
   d. Fire Alarm-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes and enclosures, use factory colored cables and conductors to identify the individual circuits. All conductors shall be stranded.

F. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

G. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

H. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

I. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

J. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

L. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

M. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

N. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

P. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

Q. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

R. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved label.
    b. Enclosures and electrical cabinets.
    c. Switchgear.
    d. Switchboards.
    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    f. Emergency system boxes and enclosures.
    g. Motor-control centers.
    h. Enclosed switches.
    i. Enclosed circuit breakers.
    j. Enclosed controllers.
    k. Contactors.
    l. Panelboards, electrical cabinets, and enclosures.
    m. Emergency system boxes and enclosures.

n. Disconnect switches.
o. Enclosed circuit breakers.
p. Control devices.

**END OF SECTION 26 0553**

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# SECTION 23 0800
# MECHANICAL SYSTEMS COMMISSIONING

## PART 1-GENERAL
## 1.0 RELATED WORK

A. All other sections in Division 21, 22 and 23. .

## 1.1 DESCRIPTION

A. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the mechanical and associated electrical Systems have been installed in the prescribed manner, and operate within the performance guidelines set in the design intent. The Commissioning Authority shall provide the Owner with an unbiased, objective view of the systems installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Authority will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers and equipment suppliers.

## 1.2 SCOPE

A. The HVAC systems commissioning shall include a demonstration by the Contractor of each equipment control sequence. The commissioning process shall demonstrate that each control sequence (including alarms and lead/lag equipment operations) and the associated test and balance data all correspond with the contract documents and with the final test and balance report. The finalized temperature control software with graphic displays shall be installed and operational (at all required locations) and the final test and balance report shall be provided for review and acceptance by the Owner and the Engineer a minimum of 10 days prior to requesting date(s) for the HVAC systems commissioning. Additionally, the temperature control contractor and the test and balance contractor (along with any other necessary parties) shall complete a 'dry-run commissioning' and shall certify in writing that all equipment is operating in accordance with the finalized written control sequences prior to requesting date(s) for the actual official on-site HVAC systems commissioning session(s).

B. The HVAC systems commissioning shall demonstrate that the quantities read and displayed by the control system are in agreement with actual' tested quantities (e.g.. variable air volume box cfm readings. minimum outside air cfm readings. air temperatures. water temperatures. duct static pressures, building static pressures, etc.). The HVAC systems commissioning shall also demonstrate that all quantities listed in the final test and balance report (cfm readings. gpm readings. temperature differences, pressure drops. etc.) are/were correctly reported.

C. The Contractor shall schedule a pre-commissioning pre-balancing meeting with the Owner's representatives at least two weeks prior to beginning the testing and balancing. This meeting will be utilized to review and discuss the finalized control sequences and to verify specific testing and balancing requirements. The final approved temperature control sequences will be distributed and reviewed during this meeting. The final control sequences will include additional detail and/or modifications to the original sequences contained in the contract documents (since such details are commonly omitted from the Mechanical Engineer's original written control sequences and are developed after the equipment submittals and the temperature control system submittals are received). The work associated with those additions and or modifications shall be provided by the temperature control contractor and the test and balance contractor at no additional cost to the Owner.

D. The Contractor shall furnish a set of two-way radios which will be utilized to expedite the commissioning process (typically a minimum of 3 fully charged radios will be necessary and required for the duration of the commissioning process).

E. The demonstration of each control sequence shall be performed under conditions which simulate as close to an actual condition as possible. The Contractor shall provide all necessary materials and temporary system modifications as required to 'false-load' the system(s) as required to demonstrate the desired sequences (including appropriate gas required to simulate a refrigerant leak in the chiller room when applicable). The temperature control system software shall be capable of temporarily overriding analog inputs in order to facilitate demonstration of the temperature control sequences. In cases where the project does not include an on-site computer in the building being commissioned the temperature control contractor shall provide a laptop computer equipped with the complete graphic interface software package (the software on the laptop computer shall be identical with the software provided to the Owner).

F. HVAC systems commissioning shall be conducted with representatives from the following entities (the required participants shall be confirmed with the commissioning agent prior to scheduling the commissioning).
   1. General Contractor (with a complete set of asbuilt plans and specifications).
   2. Mechanical Contractor (with a complete set of mechanical equipment operating and maintenance manuals that include a full set of submittals).
   3. Temperature Control Contractor (with a laptop computer loaded with the finalized programming and graphic interface software including asbuilt drawing).
   4. Test and Balance Contractor (with a complete set of testing apparatus as utilized during testing and balancing and a complete copy of the final test & balance report).
   5. Factory-authorized technicians for all major equipment (chillers, boilers, cooling towers, variable frequency drives, pumps, etc.). Technicians shall be available to verify equipment start-up has been properly completed and to make any necessary or desired adjustments to control settings.
   6. Water Treatment Contractor (with copies of final water treatment reports).
   7. Mechanical Engineer and or his designated representative.
   8. The elcetrical contractor (with complete electrical asbuilt drawings).
   9. Owner’s designated representative.

G. The aforementioned representatives shall be present during all portions of the testing (and re-testing as required) and shall be equipped to promptly remedy any deficiencies discovered during the commissioning process.

H. The temperature control contractor and the test and balance contractor (along with any other necessary parties) shall conduct a 'dry-run commissioning' to verify that all of the previously listed commissioning requirements are complete prior to requesting a date for the actualiofficial on-site commissioning session(s).

I. Should any of the aforementioned requirements not be met on the date that the commissioning process commences and or if deficiencies are observed during the commissioning process the commissioning will be considered a failure and the deficiencies will be required to be remedied and then addressed in writing prior to requesting a date for re-commissioning. There will be no additional costs allowed to the Contractor for re-commissioning sessions as may be required to address issues that are found to be in non-compliance with the requirements of this specification.

J. The Contractor shall include adequate time periods for both the 'dry-run commissioning' and the actual official on-site commissioning in the project schedule. The necessary time periods shall be carefully reviewed with all of the appropriate subcontractors to ensure that the subcontractors are in agreement with the time allotted for each scheduled task.

K. Completion and acceptance of the HVAC systems commissioning shall be a condition of Substantial Completion. The building shall be considered 'not ready to utilize for its intended use' until such time that the HVAC systems commissioning is successfully completed.

L. The responsibilities of the General/Managing Contractor shall also include:
   1. Coordinate and manage the Contractors commissioning activities.

2. Coordinate directly with each subcontractor and vendor with respect to their responsibilities and contractual obligations for commissioning.
3. Attend periodic on-site commissioning meetings as required by the Commissioning Authority.
4. Integrate commissioning schedule into the master construction activity schedule. Update schedule at specified intervals.
5. Conduct installation verification inspections.
6. Review controls documentation and interface with other systems.
7. Obtain then review operation & maintenance information and as-built drawings provided by the various subcontractors and vendors.
8. Note any inconsistencies or deficiencies in system operations. Enforce system compliance or recommend to the owners Representative modifications to system design that will correct or enhance system performance.
9. Coordinate Commissioning Authority in testing & witnessing after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
10. Be present during training sessions to direct video recording, present training and direct the presentations of others.
11. Be present during start-up activities to direct and witness execution of start-up.
12. Monitor performance of testing, adjusting and balancing activities to ensure acceptable results, and use of approved methods and instrumentation.
13. Ensure that necessary test instrumentation is available during verification and functional performance testing and those instruments meet quality and calibration requirements and are in good working order.
14. Be present during verification and functional performance testing and retesting to direct and witness execution of tests.
15. In the event that a commissioning test fails, determine the cause of failure, direct timely correction of deficiency and then retest. Reimburse the Owner, Design Team & Commissioning Authority for billed costs (including travel expenses) for the extraordinary participation of the Owners Representative, Architect, Commissioning Authority or owners staff (Extraordinary Participation shall be defined as any test that has failed more then TWO (2) times and requires Three (3) or more tests).
16. Track commissioning deficiencies until correction and retesting is successfully completed.

M. The functions and responsibility of the Commissioning Authority shall include:

1. Responsibility: The primary point of responsibility is to inform the Contractor and the Owner on the status, integration, and performance of systems within the facility.
2. Information: The Commissioning Authority shall function as a catalyst and initiator to disseminate information and assist the design and construction teams in the completion of the construction process. This shall include system completeness, performance, and adequacy to meet the intended performance standards of each system. Services include construction observation, spot testing, verification and functional performance testing, and providing performance and operating information to the responsible parties, e.g., contractors, design professionals, and the Owner.
3. Quality Assurance: Assist the responsible parties to maintain a high quality level of installation and system performance.
4. Observation of tests: Commissioning Authority shall observe and coordinate testing as required to ensure system performance meets the design intent. Documentation of tests: Commissioning Authority shall document the results of the performance testing directly and/or ensure that all testing is documented by the appropriate technicians. The Commissioning Authority shall provide standard forms to be used by all parties for consistency of approach and type of information to be recorded.
5. Resolution of disputes: The Commissioning Authority is to remain an independent party present on the project with specific knowledge of the subject. Should disputes arise, the Commissioning Authority shall perform research to determine the scope and extent of the problem and educate the involved parties as to the nature and extent of the problem. This shall include technical and financial aspects of the dispute, including assistance to help

identify who the responsible parties are to implement corrective action. The Owner/Architect shall preside over resolution of the problem.

6. Deficiencies: Provision of technical expertise to oversee and verify the correction of deficiencies found during the commissioning process.
7. Provision of technical expertise to review and edit operating and maintenance descriptions by system.

## 1.3 SYSTEMS TO BE INCLUDED IN COMMISSIONING PROCESS

A. The following pieces of equipment and systems shall go through commissioning:

1. Mechanical & central plant systems including electrical that connects to mechanical.
2. Variable frequency drives (if applicable).
3. ATC control systems, hardware, software, and documentation.
4. Electrical & lighting systems.
5. Closed Circuit TV/TV & Digital Recording System (if applicable).
6. Sound & Intercommunications Systems (if applicable).
7. Security Systems (if applicable).
8. Fire Alarm & Detection Systems (if applicable).
9. Uninterruptible power supplies over 5 KW (if applicable).
10. Building Envelope (if applicable).

## 1.4 COORDINATION

A. The Commissioning authority shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings directly from the Architect and Contractor.

B. The Commissioning Authority shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C. The Commissioning Authority is primarily responsible to the Owner, and as such, shall regularly appraise the Architect, the Contractor, and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the owner (credits, change orders, schedule changes, etc.) shall be identified and quantified as soon as possible.

D. The Commissioning Authority shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire Mechanical system is completed.

## 1.5 SCHEDULE

A. Commissioning of systems shall proceed per the criteria established, in the specific sections that follow, with activities to be performed on a timely basis. The Commissioning Authority shall be available to respond promptly to avoid construction delays.

B. Start-up and testing of systems may proceed prior to final completion of systems to expedite progress. However, the Commissioning Authority shall not perform testing and checkout services that are the primary responsibility of the contractor/vendor in advance of their testing and checkout.

C. Problems observed shall be addressed immediately, responsible parties notified, and actions to correct deficiencies coordinated in a timely manner.

D. Contractor schedules and scheduling is the responsibility of the Contractor. The Commissioning Authority shall provide commissioning scheduling information to the Contractor for review and planning activities.

E. The following list is a general set of tasks and criteria along with an approximate duration for each task. This list is intended to be utilized as a guideline for creating an appropriate schedule for all of the work related to HVAC systems commissioning. The actual time required for each task will vary depending on the size and complexity of the mechanical systems on the particular project. Determination of the actual time required for each task is the responsibility of the Contractor and shall be developed utilizing thorough review and discussion with all of the involved subcontractors prior to preparing and submitting the proposed schedule. A typical project requires between 4 and 8 weeks from start of test and balance to scheduling the dates for the formal on-site commissioning session(s).

1. Pre-commissioning/pre-balancing meeting ( 2 weeks prior to start of testing and balancing).
2. Begin testing and balancing (typically a 1 to two week process).
3. Print and distribute final test and balance reports (typically a 1 to 2 week process).
4. Temperature control contractor (with participation from test and balance contractor and mechanical contractor as necessary) conducts 'dry-run commissioning' (utilizing the Commissioning 'HVAC Systems Commissioning Checklist' as a guide) and tuning all control loops (typically 3 week process). Note that this task occurs after testing and balancing is complete.
6. Schedule formal on-site HVAC systems commissioning dates (typically a 1 to 3 day process).

## 1.6 RELATED WORK SPECIFIED ELSEWHERE

A. Commissioning requires support from the contractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

## 3.1 COMMISSIONING PLAN, SCHEDULE AND SUBMITTALS

A. The Commissioning Authority shall develop and submit a schedule for the commissioning process which is integrated with the construction schedule. Included shall be the required work by all team members (Commissioning Authority, design team, contractors, and the Owner). Overlay with the construction schedule, and include time for test and balance, verification, and functional performance testing.

**B. The subcontractor, supplier and manufacturer are responsible to submit with initial submittals a line by line submittal compliance document. The compliance document will follow the specification that the submittal is in reference too. The compliance document will have one of the following for each paragraph of the specification: Comply, Exception, or Unable to Comply. With each Exception and Unable to Comply the compliance document will have a detailed explanation.**

**C. The subcontractor, supplier and manufacturer shall attend a submittal review meeting before any piece of equipment shall be ordered.. This meeting will be held and conducted by the Commissioning Authority at a place designated by Commissioning Authority (which**

**typically is the General Contractors Trailer). During this meeting the CxA, Engineer, and Owner will review the submittal compliance document.**

## 3.2 CONSTRUCTION OBSERVATION

A. This is and additional and separate activity provided by the design team. Construction observation is required as part of the commissioning and coordination process provided by the C/A.

## 3.3 TEST AND BALANCE

A. Air & water balance shall be accomplished by the test and balance firm. The Commissioning Authority shall spot check this work to verify accuracy of results (a pot check may include 10% - 50% of the entire system this will be determined by the Commissioning Authority). If spot testing indicates balancing is not in compliance with the contract documents "ALL" mechanical systems may be retested as noted in section **1.2 Scope.**

## 3.4 VERIFICATION AND FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. Commissioning Authority shall develop and document the commissioning procedure to be used. Include a performance checklist and performance test data sheets for each system based on actual system configuration. These procedures shall be reviewed by the appropriate design engineers for technical depth, clarity of documentation and completeness. Emphasis shall be placed on testing procedures that shall determine actual system performance and compliance with the design intent.

B. The majority of mechanical equipment requires safety devices to stop and/or prevent operation unless minimum safety standards or conditions are met. These may include adequate oil pressure, proof-of-flow, non freezing conditions, maximum static pressure, maximum head pressure, etc. The Commissioning Authority shall observe the actual performance of safety shutoffs in a real or closely simulated condition of failure.

C. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or operate from software. Operation of these interlocks shall be verified by the Commissioning Authority.

D. The Commissioning Authority shall determine the acceptance procedures for each system within MEP divisions as required. The acceptance procedures shall incorporate the commissioning standards and successful testing results as referred to throughout mechanical and electrical specifications.

1. In particular, the temperature control system shall have all I/O (input/output) points individually verified for proper function, calibration, and operation. The Commissioning Authority shall review proposed testing procedures and report formats, and observe sufficient field testing to confirm that all I/O points have been properly tested.
2. All control sequence of operation strategies, alarm generation and reporting shall also be reviewed and proper operation verified by the Commissioning Authority.
3. The central work station graphics, point assignments, alarm messages, and logging functions shall be verified.
4. **A minimum Three (3) weeks of "Clean" trending (no mechanical, software, control loop or Building Management System "BMS" failures) shall be provided on "Any" or "All" BMS systems & points as directed by the C/A. Clean Trending shall be a requirement that is completed prior to Substantial Completion.**

E. The appropriate contractor and vendor(s) shall be informed of what tests are to be performed and the expected results. Whereas some test results and interpretations may not become evident until the actual tests are performed, all parties shall have a reasonable understanding of the requirements. The Commissioning Plan shall address those requirements and be distributed to all parties involved with that particular system.

F. Acceptance procedures shall confirm the performance of systems to the extent of ' the design intent. When a system is accepted, the Owner shall be assured that the system is complete, works as intended, is correctly documented, and operator training has been performed.

## 3.5 HVAC SYSTEMS COMMISSIONIG CHECKLIST

Review location of outside air temperature sensor.

Verify: calibrate outside air sensor (dry bulb & relative humidity). Verify wet bulb temperature calculation.

Verify outside air economizer control sequence and operation.

Verify direct/indirect cooling sequence is funtioning as required (if applicable).

Verify all valves and dampers have been programmed to operate without hunting.

Verify programming of vfd's (minimum speed, auto restart, input/output speed calibration, alarm on failure, upward and downward ramp time settings).

Verify vav box maximum, minimum, and reheat cfm air flows (random verification).

Verify vav box discharge air temperature (in both heating and cooling modes).

Verify diffuser air flows at vav box maximum cfm (random verification).

Verify set-up of all required alarms (review automatic dial or automatic e-mail set-up).

Verify calibration of air filter alarms.

Verify set-up of occupancy schedules.

Verify set-up of holiday schedules.

Verify unoccupied mode operation (damper and valve positions).

Verify night set-back (heating) control sequence.

Verify night set-back (cooling) control sequence.

Verify mixed air control sequence.

Verify morning warm-up control sequence.

Verify room sensor programming. displays. and calibration.

Verify room sensor unoccupied mode override feature.

Verify pump lead/lag programming and alarm display.

Verify boiler lead/lag programming and alarm display.

Verify chiller lead/lag programming and alarm display.

Verify chiller(s) control sequence(s).

Verify pump head and gpm (all systems, compare test/ balance report to design).

Verify that pump strainers are clean.

Verify flow at heating and cooling coils (random verification).

Verify location installation of air vents in each closed loop piping system.

Verify chiller room emergency shut-down switch locations and operation.

Verify chiller room refrigerant leak detection system

Verify that mechanical system roof penetrations are properly installed (per roofing details).

Verify global. remote, and local room setpoint functions.

Verify adjustment range for local room temperature setpoints.

Verify equipment room temperature setpoints and deadbands.

Verify that all required spare parts (filters. belts. etc.) have been provided.

Verify acceptable air and noise levels throughout the building.

Verify duration of water flow at self-closing lavatory faucets.

Verify time delay before domestic hot water is available at lavatory faucets.

Verify integration of Lighting into the BMS

## 3.6 FUNCTIONAL PERFORMANCE TESTING - OBSERVATION

A. The functional performance testing shall be done by the Contractor. The Commissioning Authority shall direct and witness all of these tests. -

B. Tests shall be completed comprehensively and to the extent necessary to enable the Commissioning Authority to assure the Owner and design professional that the systems do perform per the design intent.

## 3.7 RE-TESTTNG

A. Contractor shall, at no additional cost to the Owner, repeat the complete verification test procedure for each test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved.

B. Contractor shall compensate the Owner for costs incurred as the result of tests repeated. This includes the costs for the Commissioning Authority, Design Architect, Design Engineers, and Owner--s personnel for billed costs (including travel expenses) for the extraordinary participation of the Owners Representative, Architect, Commissioning Authority or owners staff (Extraordinary Participation shall be defined as any test that has failed more then TWO (2) times and requires Three (3) or more tests).

## 3.8 CORRECTION OF DEFICIENCIES

A. Correct functional performance test deficiencies promptly and schedule retest.

B. Corrections during verification or functional performance test are generally prohibited to avoid consuming the time of personnel waiting for the test but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five minutes. If corrections are made under this exception, the failure shall be noted on the test data form. A new test data form, marked retest, shall be initiated after the correction has been made. The entire test procedure shall be repeated.

## 3.9 SOFTWARE DOCUMENT

A. Review detailed software documentation for all DDC control systems. This includes review of vendor documentation, their programming approach and the specific soft-ware routines applied to this project. Discrepancies in programming approaches and/or sequences shall be reported and coordinated in order to provide the Owner with the most appropriate, simple, and straightforward approach to software routines.

## 3.10 OPERATING AND MAINTENANCE (O&M) MANUALS

A. The Commissioning Authority shall review the draft form of the O&M manuals provided by the Mechanical contractor and the Electrical contractor. The review process shall verify that O&M instructions meet specifications and are included for all equipment furnished by the contractor, and that the instructions and wiring diagrams are specific (edited where necessary) to the actual equipment provide for this project.

B. Published literature shall be specifically oriented to the provided equipment indicating required operation and maintenance procedures, parts lists, assembly/disassembly diagrams, and related information.

C. The contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting O&M information shall be system specific, concise, to the point, and tailored specifically to this facility. The Commissioning Authority shall review and edit these documents as necessary for final corrections by the contractor.

D. The O&M manual review, and coordination efforts shall be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

## 3.11 TRAINING

A. Schedule and coordinate training sessions for the Owner's staff for each system. Training shall be in a classroom setting with the appropriate schematics, handouts, and visual/audio training aids on-site with equipment.

B. The Commissioning Authority organizes, schedules, and directs the training sessions.

C. The appropriate installing contractors shall provide training on all the major systems per specifications, including peculiarities specific to this project.

D. The equipment vendors shall provide training on the specifics of each major equipment item including philosophy, troubleshooting, and repair techniques.

E. The automatic control vendor shall provide training on the control system per their specification section.

## 3.12 RECORD DRAWINGS

A. The Commissioning Authority shall review the as-built contract documents to verify incorporation of both design changes and as-built construction details. Discrepancies noted shall be corrected by the appropriate party.

## 3.13 EXCLUSIONS

A. Responsibility for construction means and methods: The Commissioning Authority is not responsible for construction means, methods. job safety. or any, construction management functions on the job site.

D. Hands-on work by the Commissioning Authority: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Authority shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, control and function.

**END OF SECTION 230800**

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## SECTION 26 0923

## LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Indoor occupancy sensors.
3. Lighting contactors.
4. Emergency shunt relays.

B. Related Sections include the following:
1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Provide factory layout drawings showing best placement of devices. Locations shall be coordinated with other ceiling devices and air diffusers.

2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

**PART 2 - PRODUCTS**

2.1 TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. TORK #7200.

B. Electromechanical-Dial Time Switches: Type complying with UL 917.

   1. Contact Configuration: DPST.
   2. Contact Rating: 40-A resistive 20 A Inductive, 120-V ac.
   3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
   4. Astronomic time dial.
   5. Skip-a-day mode.

2.2 INDOOR OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Watt Stopper (The). – DLM technology.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   4. Mounting:

      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.3 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Square D; Schneider Electric.
4. TORK.
5. Touch-Plate, Inc.
6. Watt Stopper (The).

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements. Provide a written report of test results and sensor sensitivity/time delay settings.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 26 0923**

# SECTION 26 2416

# PANELBOARDS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

### 1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

### 1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

## 1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spare for each type of panelboard cabinet lock.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Siemens Energy & Automation, Inc.
   2. Square D; a brand of Schneider Electric.
   3. General Electric.
   4. Cutler-Hammer.

D. Enclosures: Flush- and surface As specified on the drawings -mounted cabinets.

   1. Rated for environmental conditions at installed location.

      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
      e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Finishes:

      a. Panels and Trim: Steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Same finish as panels and trim.

   5. Directory Card: Inside panelboard door, mounted in transparent card holder.

E. Incoming Mains Location: As required.

F. Phase, Neutral, and Ground Buses:

   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. Service Equipment Label: UL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

I. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

## 2.2 PANELBOARD SHORT-CIRCUIT RATING

A. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
   1. Lighting and appliance branch-circuit panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an UL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an UL.

## 2.3 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

   1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or Lugs as shown.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: As specified on the drawings.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
   f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
   i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
   j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
   l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
   m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Fasten enclosures firmly to walls and structural surfraces, ensuring tha they are permanently and mechanically anchored.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 74 inches above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

## 3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

## 3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical System”.

B. Connect wiring according to Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

## 3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Provide a written report to certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Panelboards will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 26 2416**

# SECTION 26 2726

# WIRING DEVICES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Snap switches and wall-box dimmers.
5. Wall-switch.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

### 1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Provide a sample of each type of device to be used.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

## 2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.

2. Verify voltage and Amperage.

## 2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## 2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.7 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

## 2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch-thick.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates:
1. NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
2. NEMA 3R-in-Use cover, plastic, weather resistant.

## 2.9 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

## 2.10 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with standard finish.

D. Wire: No. 12 AWG.

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: by Architect.
2. Wiring Devices Connected to Emergency Power System: Red.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

## 3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use engraved machine printing with black-filled lettering on face, and durable wire markers or tags inside outlet boxes.

## 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or

similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

**END OF SECTION 26 2726**

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# SECTION 26 2813

# FUSES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches, and enclosed controllers.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches and fuseholders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

B. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
1. Let-through current curves for fuses with current-limiting characteristics.
2. Time-current curves, coordination charts and tables, and related data.
3. Fuse size for elevator feeders and elevator disconnect switches.

C. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

D. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 5 percent of each fuse type and size, but no fewer than 2 of each type and size.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. NEMA FU 1 class is same as UL class. Class defines fuse performance category, including interrupting rating. See Editing Instruction No. 2 in the Evaluations.

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

E. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

3.2 FUSE APPLICATIONS

1. Motor Branch Circuits: Class RK1, time delay.
2. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION 26 2813**

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# SECTION 26 2816

# ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

### 1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

### 1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

## 1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

**PART 2 - PRODUCTS**

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, Single Throw, [240] [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Labeled for use as service equipment.

## 2.2 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.3 SHUNT TRIP SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Green ON pilot light.
3. 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Fire-safety and alarm relay; 120-V ac coil voltage.
7. Fire-alarm voltage monitoring relay complying with NFPA 72.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer

B. Show pole quantities and voltage and ampere ratings of MCCBs and switches on Drawings.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and $I^2t$ response.

G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.

## 2.5 MOLDED-CASE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
6. One NO/NC contact that operates only when switch has tripped.
7. Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
8. Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Provide remote control for on, off, and reset operations.

## 2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R

3. NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

### 3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

**END OF SECTION 26 2816**

# SECTION 26 5100

# INTERIOR LIGHTING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

### 1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

### 1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. Other items in finished ceiling including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.

5. Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixtures.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

## 1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.7 WARRANTY

A. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.

B. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year from date of Substantial Completion.

## 1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish stock or replacement lamps amounting to 2%, but not less than 2 lamps in each case, of each type and size lamp used in each type fixture (indoor and outdoor). Deliver replacement stock as directed to the Owner's storage space.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified on the fixture schedule in the drawings.

### 2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
      b. UV stabilized.

   2. Glass: Annealed crystal glass, unless otherwise indicated.

### 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; Instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

   1. Sound Rating: A.
   2. Total Harmonic Distortion Rating: Less than 10 percent.

3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: [20] kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.78.
7. Power Factor: [0.95] or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

C. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: [Electronic] type rated for 0 deg F starting and operating temperature with indicated lamp types.

D. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 50 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

## 2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Ballast Case Temperature: 75 deg C, maximum.

## 2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2. Master/Remote Sign Configurations:

   a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
   b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

## 2.6 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 premium instant-start low-mercury lamps, rated 28 W maximum, nominal length of 48 inches, 3100 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

C. T8 premium instant-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5 instant-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

E. T5HO instant-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

F. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

   1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
   2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
   3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
   4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
   5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
   6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

## 2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.8 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

(See Drawings)

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

**END OF SECTION 26 5100**

# DIVISION 27 - COMMUNICATIONS

Not Used

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# DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

Section 28 3111 Digital, Addressable Fire Alarm System

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## SECTION 28 3111

## DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

### PART 1- GENERAL

1.1. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, and connection of a microprocessor controlled, analog addressable, intelligent fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

1.2. SCOPE:

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance with the specifications and drawings.

B. The system shall be designed such that each signaling line circuit (SLC) shall be limited to only 80% of its total capacity is used during the initial installation.

C. All existing conduit and fire alarm equipment shall be removed.

D. Basic Performance:

1. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).

2. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).

3. Digitized electronic signals shall employ check digits or multiple polling.

4. A single ground fault or open circuit on the system Signaling Line Circuit shall Not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

E. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the FACP shall flash.

2. A local piezo electric signal in the control panel shall sound.

3. A backlit 80 character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing on the FACP and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

1.3. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.

2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

3. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

3. Show annunciator layout and main control panel module layout, configurations and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturers name(s) including technical data sheets.

2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

4. Approvals will be based on complete submissions of manuals together with shop drawings.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative for a period of five (5) years after expiration of the guaranty.

B. As part of the submittal, include a quote for a maintenance contract to provide all maintenance, test, and repair described below. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a five (5) year period after the expiration of the guaranty.

C. Maintenance and testing shall be on a semiannual basis or as required by the local AHJ. A preventive maintenance schedule shall be provided which describes the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.

2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.6. POST CONTRACT EXPANSIONS:

A. The contractor shall provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

B. As part of the submittal include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include analog addressable smoke detectors, heat detectors, manual stations, monitor modules and control modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. Quotation shall include installation, final testing and labor to reprogram the system for this 10% expansion. If additional FACP hardware would be required, include the material and labor necessary to install this hardware.

D. Do not include cost of conduit or wire or the cost to install conduit or wire.

E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA) - USA:

No. 70 National Electric Code (NEC)
No. 72 National Fire Alarm Code
No. 90A Air Conditioning Systems
No. 92A Smoke Control Systems
No. 92B Smoke Management Systems in Malls, Atria, Large Areas
No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 50 Cabinets and Boxes
No. 268 Smoke Detectors for Fire Protective Signaling Systems
No. 864 Control Units for Fire Protective Signaling Systems
No. 268A Smoke Detectors for Duct Applications.
No. 521 Heat Detectors for Fire Protective
No. 228 Door Closers-Holders for Fire Protective Signaling Systems.
No. 464 Audible Signaling Appliances.
No. 38 Manually Actuated Signaling Boxes.
No. 346 Waterflow Indicators for Fire Protective Signaling Systems.
No. 1481 Power supplies for Fire Protective Signaling Systems.
No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
No. 1971 Visual Notification Appliances.

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8. APPROVALS:

A. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc

B. Modular Labeling

The fire alarm control panel shall meet the modular listing requirements of Underwriters Laboratories Inc. To facilitate system changes and expansions, and to ensure that all subassemblies have the proper listing, each subassembly of the FACP shall carry the appropriate UL modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts.

## PART 2.0 PRODUCTS

### 2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### 2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient

suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring must be new.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.

6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

7. The Fire Alarm Control panel shall be capable of T-Tapping Class B (NFPA Style 4) Signaling Line Circuits. Systems which do not allow, have restrictions to, for example, the amount of T-Taps, length of T-Taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG (3.25 mm#). The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3. MAIN FIRE ALARM CONTROL PANEL:

A. The main FACP Central Console shall be a NOTIFIER Model NFS2-3030 and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, ad-

dressable modules, local and remote operator terminals, printers, annunciators, and other system controlled devices.

1. Function: The main FACP shall perform the following functions:

   a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

   b. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

   c. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

   d. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

      1. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

         a. The system alarm LED shall flash.

         b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

         c. The 80-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

         d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

         e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

      2. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

         a. The system trouble LED shall flash.

         b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

         c. The 80-character backlit LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.

         d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.

3. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The system trouble LED shall flash.

b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

c. The 80-character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.

d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

B. System Capacity and General Operation

1. The control panel shall be capable of expansion by 198 analog/addressable devices for a maximum system capacity of 1980 points. The system shall be capable of 2048 annunciation points per system regardless of the number of addressable devices.

2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 80 character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.

3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

4. The FACP shall be able to provide the following features:

Block Acknowledge for Trouble Conditions
Rate Charger Control
Control-By-Time (Delay, Pulse, time of day, etc.)
Automatic Day/Night Sensitivity Adjust (high/low)
Device Blink Control (turn of detector LED strobe)
Environmental Drift Compensation (Selectable ON/OFF)
Smoke Detector Pre-alarm Indication at Control Panel
NFPA 72 Smoke Detector Sensitivity Test
System Status Reports
Alarm Verification, by device, with tally
Multiple Printer Interface
Multiple CRT Display Interface
Non-Fire Alarm Module Reporting

Automatic NFPA 72 Detector Test
Programmable Trouble Reminder
Upload/Download System Database to PC Computer
One-Man Walk Test
Smoke Detector Maintenance Alert
Security Monitor Points
Alpha-numeric Pager Interface
On-line or Off-line programming

C. Central Processing Unit

1. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.

2. The Central Processing Unit shall contain and execute all control-by-event (including AND-ing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

3. The Central Processing Unit shall also provide a real-time clock for time annotation of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

4. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

5. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL864 standards.

6. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

D. Display

1. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

2. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

3. The system display shall provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide five Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, DISPLAY TROUBLE, and SIGNAL SILENCE.

4. The system display shall provide a 25-key touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

5. The system display shall include the following operator control switches:

SIGNAL SILENCE, LAMP TEST, RESET, SYSTEM TEST, and ACKNOWLEDGE.

E. Signaling Line Circuit (SLC) Interface Board

1. The SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 intelligent detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

2. The SLC interface board shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

3. The SLC interface board shall not require any jumper cuts or address switch settings to initialize operations.

4. The SLC interface board shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class A) circuit.

5. The SLC interface board shall be able to drive an NFPA Style 4 twisted shielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 4, no twist, no shield circuit up to 3,000 feet in length. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.

6. The SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

F. Serial Interface Board (SIB)

1. The Serial Interface Board shall provide an EIA-232 interfaces between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

2. The SIB shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports.

3. The Serial Interface Board shall provide one EIA-485 port for the serial connection to annunciation and control subsystem components.

4. The SIB shall have LEDs that will show that it is in regular communication with annunciators or other EIA-485 connected peripheral devices.

5. EIA-232 serial output circuits shall be optically isolated to assure protection from earth ground.

6. The FACP will send packets of 80 ASCII characters followed by a carriage return (ODH) and a line feed (OAH). The external monitoring computer shall recognize certain combinations of characters in certain locations within the 80 character string in order to interpolate the status of the FACP.

G. Enclosures:

1. The control panels shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

H. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.

2. It shall provide 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.

3. It shall be expandable, for additional notification appliance power, in 3.0 ampere increments.

4. It shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. It shall charge up to 55 Amp Hour batteries within a 48 hour period.

5. It shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

6. It shall be power-limited per 1995 UL864 requirements.

7. It shall provide meters to indicate battery voltage and charging current.

8. The power supply shall be capable of charging NICAD batteries up to 32 Amp Hours.

I. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet (1828.8 m) from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.

3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.

4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.

5. Communication shall include vital system status such as:

   - Independent Zone (Alarm, trouble, non-alarm, supervisory)
   - Independent Addressable Device Status
   - AC (Mains) Power Loss
   - Low Battery and Earth Fault
   - System Off Normal
   - 12 and 24 Hour Test Signal
   - Abnormal Test Signal (per UL requirements)
   - EIA-485 Communications Failure
   - Phone Line Failure

6. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

J. Auxiliary Field Power Supply - Addressable

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.

2. The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.

3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.

4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.

6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.

7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.

9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.

10. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.

11. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.

12. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.

13. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.

14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.

15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.

16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. System Circuit Supervision:

1. The FACP shall supervise all circuits to intelligent devices, annunciators and conventional peripherals and annunciate loss of communications with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate that device or devices are not responding and print the information in the history buffer and on a printer.

2. Sprinkler system valves, standpipe control valves, PIV and main gate valves shall be supervised for off-normal position.

L. Field Wiring Terminal Blocks:

For ease of service all wiring terminal blocks shall be the plug-in/removable type and be capable of terminating up to 12 AWG (3.25 mm#) wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.

M. Operators Terminal: Provide the following standard operator full-system programming functions:

1. Acknowledge (ACK/STEP) Switch:

a. Activation of the control panel acknowledge switch in response to a single new alarm and/or trouble condition shall silence the local panel piezo electric signal and change the system alarm or trouble LED from flashing mode to steady-ON mode. If additional alarm or trouble conditions exist or are detected and reported in the system, depression of this switch shall acknowledge and/or advance the 80-character LCD display to the next alarm or trouble condition.

b. A common Acknowledge switch for all events shall be used for ease of operation. Systems that utilize multiple Acknowledge switches depending on the event are unacceptable due the confusion which could materialize during an emergency situation.

c. Depression of the acknowledge switch shall silence all remote annunciator piezo sounders.

2. Signal Silence Switch:

Activation of the signal silence switch shall cause all notification appliances and relays which are programmed to do so to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards.

3. System Reset Switch:

Activation of the system reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

If the alarm condition(s) still exist, or if they reoccur in the system after system reset switch activation, the system shall then resound the alarm conditions.

4. System Test Switch:

Activation of the system test switch shall initiate an automatic test of all Analog/Addressable detectors in the system. The system test shall activate the electronics in each analog/addressable sensor, simulating an alarm condition and causing the transmission of the alarm condition from that sensor to the fire alarm control panel. The fire alarm control panel shall interpret the data from each sensor installed in the system. A report summarizing the results of this test shall be displayed automatically on the control panel's liquid crystal display, CRT and printer. This report shall display the number of detectors tested per SLC/loop, the total number tested in the system, any detector that failed, or an all "Tested OK" message. Also included shall be a time/date stamp of when the test was performed.

5. Lamp Test Switch:

Activation of the lamp test switch shall sequentially turn on all LED indicators, liquid crystal display and local piezo-electric signal, and then automatically return the fire alarm control panel to the previous condition.

N. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.

2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.

3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.

4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. System Expansion: Design the main FACP and transponders so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

P. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

2. It shall be possible to program through the standard FACP keyboard all system functions.
3. All field defined programs shall be stored in non-volatile memory.

4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands(Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

5. The system programming shall be "backed" up on a 3.5" floppy diskette utilizing an upload/download program. This system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

Q. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

R. It shall be the responsibility of the equipment supplier /installer to ensure that all equipment supplied will fit in locations designated on plans and in the specifications.

S. Specific System Operations

1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

2. Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verifica-

tion function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

3. System Point Operations:

   a. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

   b. System output points shall be capable of being turned on or off from the system keypad or the video terminal.

4. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

   a. Device Status.
   b. Device Type.
   c. Custom Device Label.
   d. Software Zone Label.
   e. Device Zone Assignments.
   f. Analog Detector Sensitivity.
   g. All Program Parameters.

5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:

6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 400 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed.

   The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.

7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

   If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.4. SYSTEM COMPONENTS:

A. Voice Evacuation Panel

B. Speakers:

1. Speakers shall operate on 24 VDC nominal.

2. Volume for the speakers shall be field adjustable with an output sound level of at least 90 dBA measured at 10 feet from the device.

3. Shall be flush or surface mounted as show on plans.

C. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.

2. Strobe intensity shall meet the requirements of UL 1971.

3. The flash rate shall meet the requirements of UL 1971.

D. Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.

2. Shall meet the requirements of Section B listed above for visibility.

E. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.

2. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches. Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.

3. Detectors shall be Analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.

4. Addressable smoke and thermal detectors shall provide dual (2)status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.

6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.

8. The following bases and auxiliary functions shall be available :

a. Sounder base rated at 85 DBA minimum.

b. Form-C Relay base rated 30VDC, 2.0A

c. Isolator base

9. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

F. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

G. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

H. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

I. Intelligent Duct Smoke Detector

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

J. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

K. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted backbox.

3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

2.5. BATTERIES AND EXTERNAL CHARGER:

A. Battery:

1. Shall be a 12 volt, Gell-Cell type.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

B. External Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/208-volt 50/60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.

## PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.2. TYPICAL OPERATION:

A. Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

1. Activate all programmed notification circuits until silenced.

2. Actuate all strobe units until the panel is reset.

3. Annunciate the active initiating devices and zones.

4. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.

5. Return all elevators to the primary or alternate floor of egress.
6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.

7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.

8. Duct type smoke detectors shall, in addition to the above functions shut down the ventilation system or close associated control dampers as appropriate.

9. Activation of any sprinkler system low pressure switch, or valve tamper switch shall cause a system supervisory alarm indication.

3.3. TEST:

Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   Perform 24 hour battery test. AC-power to be turned off at the end of 24 hours. Test the entire system notification devices for a minimum of 5 minutes. If failed, add additional batteries, power supplies, etc. as required.

2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates.

5. Open signaling line circuits and verify that the trouble signal actuates.

6. Open and short notification appliance circuits and verify that trouble signal actuates.

7. Ground initiating device circuits and verify response of trouble signals.

8. Ground signaling line circuits and verify response of trouble signals.

9. Ground notification appliance circuits and verify response of trouble signals.

10. Check presence and audibility of tone at all alarm notification devices.

11. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.

12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

13. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4. FINAL INSPECTION:

At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

3.5. INSTRUCTION:

A. Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

C. Refer to specification section 17000 for project commissioning requirements.

3.6 The equipment and systems referenced in this section are to be commissioned per Section 01810 – Commissioning General Requirements and Section 16995 – Commissioning: Mechanical Systems. The contractor, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

**END OF SECTION 28 3111**

# DIVISION 31 - Earthwork


| | |
|---|---|
| Section 31 0700 | General site Construction Requirements |
| Section 31 1000 | Site Clearing |
| Section 31 2000 | Earth Moving |
| Section 31 5000 | Excavation Support and Protection |

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**SECTION 310700**

**GENERAL SITE CONSTRUCTION REQUIREMENTS**

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited to
1. General procedures and requirements for Site Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Site Verification Of Conditions
1. 48 hours minimum prior to performing any work on site, contact Blue Stakes to arrange for utility location services.
2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
3. Perform investigative excavating 5 days minimum in advance of performing any excavation or underground work.
4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within 24 hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.
5. Notify Owner of utilities a minimum of 48 hours prior to an work taking place.

3.2 PREPARATION

A. Protection
1. Spillage -
a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
2. Dust Control -
a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
b. Correct or repair damage caused by dust.
3. Erosion Control -
a. Take precautions necessary to prevent erosion and transportation of soil downstream, to adjacent properties, and into on-site or off-site drainage systems.
b. Develop, install, and maintain an erosion control plan if required by law.
c. Repair and correct damage caused by erosion.
4. Existing Plants And Features - Do not damage tops, trunks, and roots of existing trees and shrubs on site which are intended to remain. Do not use heavy equipment within branch spread. Interfering branches may be removed only with

permission of Architect. Do not damage other plants and features which are to remain.

5. Protect site from fire caused by welding, cutting, smoking, or other sources of ignition.

B. If specified precautions are not taken or corrections and repairs made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of the Work.

3.3 REPAIR / RESTORATION

A. Adjust existing covers, boxes, and vaults to grade.

B. Replace broken or damaged covers, boxes, and vaults.

C. Independently confirm size, location, and number of covers, boxes, and vaults which require adjustment.

3.4 FIELD QUALITY CONTROL

A. Notify Architect 48 hours prior to performing excavation or fill work.

B. If work has been interrupted by weather, scheduling, or other reason, notify Architect 24 hours minimum prior to intended resumption of grading or compacting.

C. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils which have been exposed to adverse weather conditions.

END OF SECTION 310700

**SECTION 311000**

**SITE CLEARING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on demolition plan.
   2. Clearing and grubbing.
   3. Stripping and stockpiling topsoil.
   4. Removing above- and below-grade site improvements.
   5. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities.
   6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

   1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.
   2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security, protection facilities, and temporary erosion and sedimentation control procedures.
   3. Division 01 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
   4. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
   5. Division 02 Section "Structure Demolition" for demolition of buildings, structures, and site improvements.
   6. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
   7. Division 23 Section "Turf, Grasses, and Plants" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

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

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

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

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control Drawings, a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent**.**

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

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

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

## 3.4 UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

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

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 21, Division 22, Division 26, Division 27, and Division 28 Sections covering site utilities.

## 3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Remove tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

## 3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 120 inches.
2. Dispose of excess topsoil as specified for waste material disposal.
3. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

## 3.7 SITE IMPROVEMENTS

A. Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction. Refer to project plans for improvements to be abandoned in place.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

## 3.8 DISPOSAL

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

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

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**SECTION 312000**

**EARTH MOVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to the Geotechnical Report titled “Geotechnical Investigation”, for additional grading requirements.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing sub-grades for slabs on grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling for utility trenches.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for quantity allowance provisions related to unit-price rock excavation and authorized additional excavation.
2. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
3. Division 01 Section Construction Progress Documentation and Photographic Documentation for recording pre-excavation and earthwork progress.
4. Division 01 Section “Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
5. Division 01 Section "Temporary Tree and Plant Protection" for protecting and trimming trees to remain.
6. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
7. Divisions 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
8. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above-grade and below-grade improvements and utilities.
9. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.

10. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
11. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
12. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.
13. Division 33 Section "Sub-drainage" for drainage of foundations, slabs on grade, walls, and landscaped areas.

## 1.3 UNIT PRICES

A. Unit prices for earthwork are included in Division 01 Section "Unit Prices."

B. Quantity allowances for earthwork are included in Division 01 Section "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24-inches outside of concrete forms other than at footings.
2. 12-inches outside of concrete forms at footings.
3. 6-inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6-inches beneath bottom of concrete slabs-on-grade.
6. 6-inches beneath pipe in trenches, and the greater of 24-inches wider than pipe or 42-inches wide.

## 1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

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

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

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

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

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the work.
2. Bulk Excavation: Excavation more than 10-feet in width and more than 30-feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

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

H. Rock: Rock material in beds, ledges, un-stratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cubic yard for bulk excavation or 3/4 cubic yard for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090-lbf and stick-crowd force of not less than 18,650-lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

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

## 1.5 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.

B. Samples: 12-by-12-inch Sample of sub-drainage and other geotextiles used.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D698 or ASTM D1557 for each on-site and borrow soil material proposed for fill and backfill.

D. Blasting Plan: For record purposes and for approval of authorities having jurisdiction.

E. Seismic Survey Report: For record purposes; from seismic survey agency.

F. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

## 1.6 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

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

D. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

# PART 2 - PRODUCTS

## 2.1 SOIL MATERIALS

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

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these groups; free of rock or gravel larger than 3-inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Native rock crushed to meet the above requirements and free from significant porosity may also be used as satisfactory soils.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 3/4-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed or crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## 2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Non-woven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.

7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type II.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch to 3/8-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
2. Compressive Strength: 80 psi , when tested according to ASTM C 495.

## 2.4 ACCESSORIES

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

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows when required by utility purveyor:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

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

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

1. Explosives: Not Permitted

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs on grade.
f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

## 3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

## 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

## 3.7 EXCAVATION FOR UTILITY TRENCHES

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

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

## 3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons or vehicle with similar unit axel weight.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

## 3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

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

## 3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations.

## 3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

## 3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

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

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 12 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

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

## 3.13 SOIL FILL

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

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

## 3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

## 3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12-inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Reduce loose depths as needed to achieve required compactions.

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

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent if in landscaping areas or 95 percent if under structures, pavements, or walks.

## 3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch
3. Pavements: Plus or minus 1/2 inch

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

## 3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor].
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

## 3.18 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends where called for on details and on plans.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase and base course to required crown elevations and cross-slope grades.
4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557 where called for on project plans.

## 3.19 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

## 3.20 FIELD QUALITY CONTROL

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

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

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

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

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

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

## 3.21 PROTECTION

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

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

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**SECTION 315000**

**EXCAVATION SUPPORT AND PROTECTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation and Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
3. Division 31 Section "Dewatering" for dewatering system for excavations. **(Not Used)**

1.3 PERFORMANCE REQUIREMENTS

A. Design**,** furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

A. Shop Drawings: For excavation support and protection system.

B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordinate first paragraph below with qualification requirements in Division 01 Section "Quality Requirements."Qualification Data: For qualified professional engineer.

D. Other Informational Submittals:

1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

    a. Note locations and capping depth of wells and well points.

## 1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:

    a. Geotechnical report.
    b. Existing utilities and subsurface conditions.
    c. Proposed excavations.
    d. Proposed equipment.
    e. Monitoring of excavation support and protection system.
    f. Working area location and stability.
    g. Coordination with waterproofing.
    h. Abandonment or removal of excavation support and protection system.

## 1.6 PROJECT CONDITIONS

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

1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's, Construction Manager's, and Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for

comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. Tiebacks: Steel bars, ASTM A 722/A 722M.

I. Tiebacks: Steel strand, ASTM A 416/A 416M.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

## 3.2 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

## 3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

## 3.4 TIEBACKS

A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

## 3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.

3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

## 3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

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## SECTION 31 6600

## AGGREGATE PIER GROUND IMPROVEMENT

### PART 1: GENERAL

### 1.1 DESCRIPTION

A. **Work shall consist of designing, furnishing and installing aggregate pier ground improvement** to the lines and grades designated on the project foundation plan and as specified herein. Aggregate pier ground improvement as referenced in this specification shall be constructed by either vibro-replacement stone columns or Rammed Aggregate Pier® systems. The aggregate piers shall be in a columnar-type configuration and shall be used for support of foundation loads.

### 1.2 WORK INCLUDED

A. **All equipment, material, labor, and supervision** to design and install aggregate piers. Design shall rely on subsurface information presented in the project geotechnical report, however, the Owner does not warrant that conditions noted in the report are uniform across the project Site. Layout of aggregate piers, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.

B. Aggregate pier design and installation shall adhere to all methods and standards described in this Specification.

### 1.3 RELATED SECTIONS

A. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

B. **Division 0** Section "**Geotechnical Data**" for disclaimers regarding the geotechnical report.

### 1.4 APPROVED INSTALLERS

A. **Aggregate Pier Installer** (the Installer) **shall be approved** by the Owner's Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner's Engineer at least two (2) weeks prior to bid opening.

B. Installers of aggregate pier foundation systems shall have a **minimum of 5 years of experience** with the installation of aggregate pier systems and shall have completed at least 50 projects.

C. **Installers licensed by the Aggregate Pier system manufacturer** will be accepted as approved installers.

D. **Approved Installers:**
1. Advanced Geosolutions, Inc; www.advgeosolutions.com
2. Jones Shoring (Jones Excavating Co.); 5633 W. Axel Park Road, West Jordan, UT 84088 Phone 801.280.2908

3. Subsurface Constructors; 101 Angelica Street, Saint Louis, MO 63417 Phone 314.421.2479
4. Hayward Baker, 11575 Wadsworth Blvd., Broomfield, Colorado 80020 Phone 303.469.1136.
5. Malcolm Drilling; www.malcomdrilling.com

## 1.5 REFERENCE STANDARDS

A. **Design Criteria**
1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.
2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE, 2, 962-974.
3. "Behavior of Geopier®-Supported Foundation Systems during Seismic Events," by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.
4. "The design of vibro-replacement." H.J. Priebe. Ground Engineering, London. Dec 1995.

B. **Modulus Testing**
1. ASTM D 1143 - Pile Load Test Procedures
2. ASTM D 1194 - Spread Footing Load Test

C. **Materials and Inspection**
1. ASTM D 1241 - Aggregate Quality
2. ASTM D 422 - Gradation of Soils

D. Where specifications and reference documents conflict, the Aggregate Pier Designer shall make the final determination of the applicable document.

## 1.6 CERTIFICATION AND SUBMITTALS

A. **Design Calculations:** Installer shall submit detailed design calculations and construction drawings prepared by the Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.
1. **Deferred submittal**: To be submitted to the Building Code Official for structural peer review.
2. Submit design to Building Code Official no later than 7 days following the Notice of Award of Contract. The building permit will not be issued until the design of the aggregate pier system has been approved by the Building Code Official.

B. **Professional Liability Insurance**: The Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy shall provide a minimum coverage of $3 million per occurrence.

C. **Building Code Acceptance**: The Aggregate Pier Installer shall demonstrate that the Aggregate Pier system has been evaluated by the International Code Council (ICC).

D. **Modulus Test Reports**: A modulus test(s) is performed on a non-production Aggregate Pier element as required by the Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, and complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer.

E. **Daily Aggregate Pier Progress Reports**: The Installer shall furnish a complete and accurate record of Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

A. **Basis of Design**: Geopier Foundation Company "Rammed Aggregate Piers"; www.geopier.com

B. A**lternate systems shall be submitted for review** by the Architect and the structural engineer prior to the receipt of bids. Alternative systems are subject to all requirements of these specifications. Documentation shall verify compliance with design criteria outlined herein and as shown on the Drawings.

### 2.2 AGGREGATE

A. **Aggregate** used by the Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.

B. **Potable water** or other suitable source shall be used to increase aggregate moisture content where required.

### 2.3 DESIGN REQUIREMENTS

A. **Aggregate Pier Design**

1. Design of the Aggregate Pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Aggregate Pier system. The Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50 years.
2. **Design shall meet the following criteria:**
   a. Maximum Allowable Bearing Pressure for Footings Supported by Aggregate Pier Reinforced Soils: 7,500 psf

b. Estimated Total Long-Term Settlement for Footings: less than or equal to 1-inch

c. Estimated Long-Term Differential Settlement of Adjacent Footings: less than or equal to 1/2 inch

B. **Design Submittal**

1. Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval no later than seven (7) days following the Notice of Award. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

## PART 3 - EXECUTION

### 3.1 APPROVED INSTALLATION PROCEDURES

A. **The following sections** provide general criteria for the construction of the Aggregate Piers. Unless otherwise approved by the Designer, the installation method used for Aggregate Pier construction shall be that used in the construction of the successful modulus test.

B. **Aggregate Piers installed using augered Rammed Aggregate Pier systems** -

1. Augered Rammed Aggregate Pier systems shall be pre-augered using mechanical drilling or excavation equipment.
2. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity or a displacement Rammed Aggregate Pier system may be used.
3. Aggregate shall be placed in the augered cavity in compacted lift thicknesses no greater than 24 inches as determined by the Aggregate Pier Designer.
4. Should cave-ins occur on top of a lift of aggregate such that the volume of the caved soil is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.
5. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The tamper diameter shall be at least 80% of the pre-augered hole diameter. The apparatus shall apply direct downward impact energy to each lift of aggregate.

C. **Aggregate Piers Installed Using Vibro-replacement Stone Columns**

1. If vibro-replacement stone column construction is used to construct the Aggregate Piers, the Installer shall use an electric down-hole vibroflot (probe) capable of providing at least 200 HP of rated energy and a centrifugal force of 30 tons. The vibroflot diameter must be at least 60% of the Aggregate Pier design diameter. An appropriate metering device should be provided at such a location that inspection of amperage build-up may be verified during the operation of the equipment. Metering device may be an ammeter directly indicating the performance of the vibroflot tip of the eccentric. Complete equipment specifications should be submitted to the Engineer prior to commencement of the fieldwork.

2. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer's approved construction drawings. The probe, used in combination with the available pressure to the tip jet, shall be capable of penetration to the required tip elevation. Pre-augering shall be used to aid penetration. Use pre-auguring to aid penetration. Do not use water jetting as a penetration aid.
3. The probe shall penetrate into the foundation soil layer to the minimum depths required in the installer's construction plans. After penetration to the required depth, the probe shall not be withdrawn more than 2 feet at any time unless the stone stops flowing to the bottom of the probe.
4. Redriving the probe into the treated depth shall be attempted at approximately 12 to 18-inch intervals to observe resistance to penetration and amperage build-up. During redriving, the probe tip shall penetrate to within 1 foot of the previous redriving depth.
5. Amperage build-up and backfill quantities will be contingent upon the type of probe used and procedures. Prior to commencement of work, the Contractor shall discuss the equipment capabilities with the Engineer to determine if trial probes will be necessary.
6. The Installer shall provide a full-time quality control technician on-site during the installation process.

D. **Plan Location and Elevation of Aggregate Piers**
1. The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

E. **Rejected Aggregate Piers**
1. Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

## 3.2 QUALITY CONTROL

A. **Control Technician**
1. The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Aggregate Pier Designer, the General Contractor, and to the Testing Agency. The quality control procedures shall include the preparation of Aggregate Pier Progress Reports completed during each day of installation containing the following information:
   a. Footing and Aggregate Pier location.
   b. Pre-auger diameter and soil conditions encountered during drilling (if required).
   c. Aggregate Pier length.
   d. Planned and actual Aggregate Pier elevations at the top and bottom of the Aggregate Pier.
   e. Average lift thickness of each Aggregate Pier.
   f. Volume of aggregate used in each Aggregate Pier.
   g. Documentation of any unusual conditions encountered.
   h. Type and size of densification equipment used.

B. **Aggregate Pier Modulus Test**

1. When authorized, an Aggregate Pier Modulus Test(s) shall be performed at locations agreed upon by the Aggregate Pier Designer and the Testing Agency to verify or modify Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Aggregate Pier design submittal. Aggregate Piers shall be tested to 150 percent of the maximum design stress as shown in the aggregate pier design submittal. The modulus tests shall be of the type and installed in a manner specified herein.
2. A telltale shall be installed at the bottom of the test pier so that bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 30% of the top of pier deflection at the design stress level.
3. ASTM D-1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, and load decrements. As a minimum, the following loading increments, decrements and duration shall be used.

| Increment | Approximate Load (Percent design) | Minimum Duration | Maximum Duration |
|---|---|---|---|
| Seat | <9 | 0 | N/A |
| 1 | 17 | 15 | 60 |
| 2 | 33 | 15 | 60 |
| 3 | 50 | 15 | 60 |
| 4 | 67 | 15 | 60 |
| 5 | 83 | 15 | 60 |
| 6 | 100 | 15 | 60 |
| 7 | 117 | 60 | 120 |
| 8 | 133 | 15 | 60 |
| 9 | 150 | 15 | 60 |
| 10 | 100 | N/A | N/A |
| 11 | 66 | N/A | N/A |
| 12 | 33 | N/A | N/A |
| 13 | 0 | N/A | N/A |

C. With the exception of the load increment representing approximately 117% of the design maximum top of Aggregate Pier stress, **all load increments shall be held for a minimum of 15 minutes**. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 1 hour, whichever is occurs first.

D. Load increment that represents approximately 117% of the design maximum stress on the Aggregate Pier shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 4 hours, whichever is occurs first.

E. **A seating load equal to 5 percent** of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.

F. **Bottom Stabilization Testing (BSTs) / Crowd Stabilization Testing (CSTs)**

1. Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. The tests are performed by applying downward vertical energy to the tamper, mandrel or probe following lift construction and monitoring the amount of additional deflection from the applied energy. Additional testing as required by the Aggregate Pier Designer (typically 10% of the production Aggregate Piers) shall be performed on selected production Aggregate Pier elements to compare results with the modulus test pier.

## 3.3 QUALITY ASSURANCE

A. **Independent Engineering Testing Agency (Owner's Quality Assurance)**

B. The Aggregate Pier Installer shall provide **full-time Quality Control monitoring of Aggregate Pier construction activities**. General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

C. **Responsibilities of Independent Engineering Testing Agency**

1. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.
2. The Testing Agency shall monitor the installation of Aggregate Piers to verify that the production installation practices are similar to those used during the installation of the modulus test elements.
3. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.
4. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

## 3.4 RESPONSIBILITIES OF THE GENERAL CONTRACTOR

A. **Site Preparation and Protection**

1. Locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Piers.
2. Site grades for aggregate pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize aggregate pier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Rammed Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.
3. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Aggregate Pier installation.
4. Prior to, during and following Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.
5. If spoils are generated by aggregate pier installation, spoil removal from the aggregate pier work area in a timely manner to prevent interruption of aggregate pier installation is required.

B. **Aggregate Pier Layout**

1. The location of aggregate pier-supported foundations for this project, including layout of individual aggregate pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

C. **Contractor's Independent Testing Agency (Owner's Quality Assurance)**

1. General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 6 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 5 of this specification.

D. **Excavations for Obstructions**

1. Should any obstruction be encountered during Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location.
2. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

E. **Utility Excavations**

1. The General Contractor shall coordinate all excavations made subsequent to Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Aggregate Pier construction drawings. Protection of completed Aggregate Piers is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Aggregate Piers, the General Contractor shall contact the Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

F. **Footing Bottoms**

1. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.
2. Foundation excavations to expose the tops of Aggregate Piers shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Aggregate Piers before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Aggregate Piers and the concrete footing.
3. All excavations for footing bottoms supported by Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:
   a. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).
   b. Compaction of surface soil and top of Aggregate Piers shall be prepared using a motorized impact compactor (“Wacker Packer,” “Jumping Jack,” or similar). Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.
   c. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.
4. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:
   a. That water has not been allowed to pond in the footing excavation at any time.
   b. That all Aggregate Piers designed for each footing have been exposed in the footing excavation.

c. That immediately before footing construction, the tops of Aggregate Piers exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.

d. That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Aggregate Pier construction drawings, without the written approval of the Installer or Designer.

5. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Aggregate Pier Installer, may void any written or implied warranty on the performance of the Aggregate Pier system.

## 3.5 PAYMENT

A. Measurement of the aggregate piers is on a lump sum basis.

B. Payment shall cover design, supply and installation of the aggregate pier foundation system. Excavation of unsuitable materials, delays, re-engineering, and remobilization as documented and approved by the Owner or Owner's Engineer, shall be paid for under separate pay items.

**END OF SECTION**

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# DIVISION 32 – Exterior Improvements


| | |
|---|---|
| Section 32 1216 | Asphalt Paving |
| Section 32 1313 | Concrete Paving |
| Section 32 3113 | Chain Link Fences |

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# SECTION 321216

# ASPHALT PAVING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Asphalt surface treatments.
6. Pavement-marking paint.
7. Traffic-calming devices.
8. Imprinted asphalt.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.
5. Division 32 Section "Unit Paving" for bituminous setting bed for pavers.

### 1.3 UNIT PRICES

A. Work of this Section is affected by unit prices and as defined in Division 1.

### 1.4 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

## 1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each paving fabric, 12 by 12 inches minimum if used.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each paving fabric, 12 by 12 inches minimum.
2. Each type and color of preformed traffic-calming device.
3. Each pattern and color of imprinted asphalt and precut marking material.

E. Qualification Data: For qualified manufacturer and Installer.

F. Material Certificates: For each paving material, from manufacturer.

G. Material Test Reports: For each paving material.

## 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide copy of manufactures experience for verification of qualifications.

B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of city and DOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

E. Preinstallation Conference: Conduct conference at Project site

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

## 1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F. Not used if paving takes place within 48 hours of final grading and final compaction of road base.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

C. Imprinted Asphalt Paving: Proceed with coating imprinted pavement only when air temperature is at least 50 deg F and rising and will not drop below 50 deg F within 8 hours of coating application. Proceed only if no precipitation is expected within two hours after applying the final layer of coating.

# PART 2 - PRODUCTS

## 2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

## 2.2 ASPHALT MATERIALS

A. Asphalt Cement: AC 20 per ASTM D 3381 for viscosity-graded material except use ductility at 39.2 deg. F., >5 for AC 20 and delete the loss on heating requirement on residue from “Thin-Film Oven Test”.

B. Prime Coat: Not required if paving is done within 48 hours of final compaction.

C. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Fog Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

E. Water: Potable.

F. Undersealing Asphalt: ASTM D 3141, pumping consistency.

## 2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type I Type II or III Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N, Type F, and Type S; colors complying with FS TT-P-1952.

1. Color: White, Yellow, Blue, and As indicated.

F. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: White, Yellow, Blue, and As indicated.

G. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color: White, Yellow, Blue, and As indicated.

H. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, Yellow, Blue, and As indicated.

I. Glass Beads: AASHTO M 247, Type 1.

J. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 20-inch minimum length.

## 2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located. Provide mix with the following characteristics:
   a. Number of compaction blows each end of specimen: 50.
   b. Satiability based on ASTM D5581: 1200 minimum.
   c. Flow in 0.01-inch units per ASTM D5581: 10-18.
   d. Voids in mineral aggregate VMA: 14.
   e. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture.
2. Surface Course: 3-inch minimum compacted thickness and as indicated on the drawings with aggregate meeting the following gradation table:

| | | |
|---|---|---|
| ¾ inch | 100 | Passing |
| ½ inch | 74-99 | |
| 3/8 inch | 69-91 | |
| No. 4 | 49-65 | |
| No. 8 | 33-47 | |
| No. 16 | 21-35 | |
| No. 50 | 6-18 | |
| No. 200 | 2-6 | |

B. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Verify that the road base has been properly compacted and is at the correct line, grade, and slope.

C. Verify that the road base thickness is as indicated on the project plans.

D. Verify that sufficient depth at curbs, walks, lips and other vertical edges is available to place the required thickness of compacted ashalt.

E. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons or other vehicle with similar axel weight.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

F. Proceed with paving only after unsatisfactory conditions have been corrected.

G. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

## 3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

## 3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

## 3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Not used.

C. Prime Coat: Do not use if paving takes place not more than 48 hours after final compaction and grading of road bases. If paving must be delayed significantly, re-grade and re-compact road base or apply Prime Coat. Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings.
3. Remove and replace items damaged by overspray or clean affected surfaces as directed by architect at no additional cost to owner.

## 3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt surface course in single lift if design thickness is less than 3-inches. If design thickness is more than 3-inches, place in multiple lifts with a minimum thickness of 1.5-inches and a maximum thickness of 3-inches.
2. Spread mix at minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

## 3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."**.**
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

## 3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Place asphalt so that final compacted asphalt is even with lip of gutter on curbs that drain away from the curb and gutter (open face or depressed curb and gutter). Place asphalt so that final compacted asphalt is 1/4-inch above lip of gutter on curbs that carry water (slope of parking lot is towards the curb). In transition areas, use extra care to make sure that no ponds, bird baths, or depressions are left after paving.

G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

## 3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Surface Course: 1/8 inch.
   2. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. After paving is complete, pour water on paved areas and identify ponds, bird baths, and depressions. Identify the same at open face and transition sections of curb and gutter. Remove and replace asphalt, curb and gutter, road base, and or sub-base as necessary to fix ponds, bird baths, or depressions at no additional cost to owner.

## 3.9 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow curing.

   1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

## 3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 7 days minimum days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

   1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

E. Color
   1. Yellow: Parking stalls and pedestrian crossings.
   2. Blue: Handicap insignia at appropriate stalls.
   3. Red: Fire lanes and no parking areas.
   4. White: Directional arrows.

## 3.11 WHEEL STOPS

A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

## 3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726. Cores will also be measured for compacted thickness. The owner and architect may also direct additional cores to be taken at locations of their choosing to verify final pavement thickness.

      a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
      c. Coordinate the time and locations of all holes so that cores may be filled.

E. The contractor will replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

## 3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

   1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

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**SECTION 321313**

**CONCRETE PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.
5. Unit paver base.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
3. Division 32 Section "Decorative Concrete Paving" for surface-imprinted, stamped finished concrete pavement.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

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

C. Samples: 10-lb sample of exposed aggregate.

D. Qualification Data: For manufacturer and testing agency.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

G. Field quality-control test reports.

H. Minutes of preinstallation conference.

## 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who 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."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

1. Build mockups in the location and of the 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. Obtain Architect's approval of mockups before starting construction.
4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
5. Demolish and remove approved mockups from the site when directed by Architect.
6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

## 1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

# 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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

## 2.3 STEEL REINFORCEMENT (NO REINFORCEMENT USED FOR FLATWORK)

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

E. Plain Steel Wire: ASTM A 82.

F. Deformed-Steel Wire: ASTM A 496.

G. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

H. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

I. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

J. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

## 2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement and as specified in Division 3 except that for exterior concrete, the minimum compressive strength is 4000 psi at 28 days.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 3/4 to 1 inch nominal.
2. Aggregate Source, Shape, and Color and as required by the architect.

D. Water: ASTM C 94/C 94M.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

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.

## 2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Products:

a. Monofilament Fibers:

1) Axim Concrete Technologies; Fibrasol IIP.
2) Euclid Chemical Company (The); Fiberstrand 100.
3) FORTA Corporation; Forta Mono.
4) Grace, W. R. & Co.--Conn.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth.

b. Fibrillated Fibers:

1) Axim Concrete Technologies; Fibrasol F.
2) FORTA Corporation; Forta.
3) Euclid Chemical Company (The); Fiberstrand F.
4) Grace, W. R. & Co.--Conn.; Grace Fibers.
5) SI Concrete Systems; Fibermesh.

## 2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edeco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, ChemRex Inc.; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoko; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation; Resi-Chem Clear.
m. Tamms Industries Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
b. Burke by Edoco; Resin Emulsion White.
c. ChemMasters; Safe-Cure 2000.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; Aqua Kure-White.
i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
j. Meadows, W. R., Inc.; 1200-White.
k. Symons Corporation; Resi-Chem White.
l. Tamms Industries, Inc.; Horncure 200-W.
m. Unitex; Hydro White.
n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

## 2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Color stain: Match Architect's sample or as selected by Architect from manufacturer's full range of stains.

C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

E. 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 requirements, and as follows:

1. Types I and II, non-load bearing and types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

F. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Products:

a. Burke by Edeco; True Etch Surface Retarder.
b. ChemMasters; Exposee.
c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
d. Euclid Chemical Company (The); Surface Retarder S.
e. Kaufman Products, Inc.; Expose.

f. Metalcrete Industries; Surftard.
g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.
h. Scofield, L. M. Company; Lithotex.
i. Sika Corporation, Inc.; Rugasol-S.
j. Vexcon Chemicals, Inc.; Certi-Vex Envioset.

G. Pigmented Mineral Dry-Shake Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products:

a. Conspec Marketing & Manufacturing Co., Inc.; Conshake 600 Colortone.
b. Dayton Superior Corporation; Quartz Tuff.
c. Euclid Chemical Company (The); Surflex.
d. Lambert Corporation; Colorhard.
e. L&M Construction Chemicals, Inc.; Quartz Plate FF.
f. MBT Protection and Repair, ChemRex Inc.; Mastercron.
g. Metalcrete Industries; Floor Quartz.
h. Scofield, L. M. Company; Lithochrome Color Hardener.
i. Symons Corporation; Hard Top.

2. Color: Match Architect's sample or as selected by Architect from manufacturer's full range.

H. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

## 2.8 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type I or II or AASHTO M 248, Type N or F.

1. Color: White, Yellow, Blue. See Section 321216 for color locations.

B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes.

1. Color: White, Yellow, Blue. See Section 321216 for color locations.

C. Glass Beads: AASHTO M 247, Type 1.

## 2.9 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
3. Select slump limit from options in subparagraph below or revise to suit Project.
4. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5-8 percent nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, high-range, water-reducing admixture, high-range, water-reducing and retarding admixture, plasticizing, and retarding admixture in concrete, as required, for placement and workability.

2. Specify admixtures as part of submittal. Verify that admixtures proposed do not adversely effect stained concrete and will not modify colors of stain.

3. Coordinate acceptability of admixtures with architect.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. where specified and approved in mix submittal.

H. Color Stain: Add stain to concrete per manufacturers recommendations and to meet color required by architect and owner on areas of stained concrete.

## 2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons or similar axel weight vehicle.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### 3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

## 3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. 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.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover 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 will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction 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.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

## 3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

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

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## 3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
4. Coordinate with architect the locations of each type of finish.

## 3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in pavement surfaces as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to pavement according to manufacturer's written instructions.
2. Cover pavement surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon-bristle broom.
4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on pavement surface. Tamp aggregate into plastic concrete, and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to pavement according to manufacturer's written instructions.
2. Cover pavement surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon-bristle broom.
4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. dampened slip-resistive aggregate over pavement surface in 2 applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over pavement surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

D. Rock-Salt Finish: After initial floating, uniformly spread 5 lb/100 sq. ft. rock salt over pavement surface.

1. Cover pavement surface with 1-mil-thick polyethylene sheet and remove sheet when concrete has hardened and 7-day curing period has elapsed.
2. Embed rock salt into plastic concrete, power float concrete, and trowel finish.
3. After 7-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt.

E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to pavement surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match pavement color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over pavement surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second dry-shake hardener application, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed by power floating.
3. After final floating, apply a hand-trowel finish followed by a broom finish to concrete.
4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

F. Coordinate the locations of finishes with the architect and owner prior to placing concrete.

## 3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during

finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist 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. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

## 3.10 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

## 3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 14 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Spread glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

## 3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or 5000 sq. ft. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide 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.

2. 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 mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 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.

D. 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.

E. 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.

F. 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.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.13 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

# SECTION 32 3113

# CHAIN LINK FENCES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. **This Section includes** the following:
   1. **Replacement of section of existing chain link fence** as indicated on Drawings and as required by regrading of site.

B. **Related Sections**: The following Sections contain requirements that relate to this Section:
   1. **Division 31** Section **"Earthwork"** for filling and grading work.

### 1.3 SUBMITTALS

A. **General**: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. **Product Data**: Provide product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.

C. **Shop Drawings**: Provide shop drawings showing location of fence, posts, and details of post installation, and accessories.

### 1.4 QUALITY ASSURANCE

A. **Installer Qualifications**: Engage an experienced Installer who has at least three years' experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

B. **Single-Source Responsibility**: Obtain chain link fences, including accessories, fittings, and fastenings, from a single source.

### 1.5 PROJECT CONDITIONS

A. **Field Measurements**: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

## PART 2 - PRODUCTS

### 2.1 FABRIC

A. **Selvage**: Knuckled on both selvages for 2-inch and 2-1/8-inch mesh sizes with heights of 60 inches and less.

B. **Selvage**: Knuckled at one selvage and twisted at the other for 2-inch and 2-1/8-inch mesh sizes and heights above 60 inches.

C. **Steel Chain-Link Fence Fabric**: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:
   1. **Mesh and Wire Size**: Match existing.
   2. **Coating**: Match existing.

### 2.2 FRAMING

A. **Type I Round Posts**: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per sq. ft. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

| Actual OD | Weight (lb/ft) | NPS Size |
|---|---|---|
| 1.315 | 1.68 | 1 |
| 1.660 | 2.27 | 1-1/4 |
| 1.900 | 2.72 | 1-1/2 |
| 2.375 | 3.65 | 2 |
| 2.875 | 5.79 | 2-1/2 |
| 3.500 | 7.58 | 3 |
| 4.000 | 9.11 | 3-1/2 |
| 6.625 | 8.97 | 6 |
| 8.625 | 28.55 | 8 |

B. **Top Rail**: Manufacturer's longest lengths (17 to 21 feet) with swedged-end or expansion-type coupling, approximately 6 inches long for joining. Provide rail ends or other means for attaching top rail securely to each gate corner, pull, and end post.
   1. **Round Steel**: 1.660-inch OD Type I or II steel pipe.

C. **Steel posts for fabric heights up to 6 feet**:
   1. **Round Line or Intermediate Posts**: 1.90-inch OD Type I or II steel pipe.
   2. **Round End, Corner, and Pull Posts**: 2.375-inch OD Type I or II steel pipe.

D. **Steel posts for fabric heights over 6 feet**:
   1. **Round Line or Intermediate Posts**: 2.375-inch OD Type I or II steel pipe.
   2. **Round End, Corner, and Pull Posts**: 2.875-inch OD Type I or II steel pipe.

## 2.3 FITTINGS AND ACCESSORIES

A. **Material**: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards. Final finish to match existing fencing.
   1. **Steel and Iron**: Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 oz. zinc per sq. ft. as determined by ASTM A 90.

B. **Post and Line Caps**: Provide weathertight closure cap for each post. Provide line post caps with loop to receive tension wire or top rail.

C. **Post Brace Assembly**: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.
   1. **Round Steel:** 1.660-inch OD Type I or II steel pipe.

D. **Tension or Stretcher Bars**: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4 inch, and a minimum of 1.2 oz. of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.

E. **Tension and Brace Bands**: 3/4-inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of zinc coating per sq. ft.
   1. **Tension Bands:** 0.074 inch thick (14 gage) minimum.
   2. **Brace Bands**: 0.105 inch thick (12 gage) minimum.

F. **Tension Wire**: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.
   1. **Coating Type II zinc** in the following class as determined by ASTM A 90.
      a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.

G. **Tie Wires**: 0.106-inch-diameter (12-gage) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating according to ASTM A 641, Class 3 or 0.148-inch-diameter (9-gage) aluminum wire alloy 1350-H19 or equal, to match fabric wire.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. **General**: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
   1. Apply fabric to outside of framework. Install fencing on boundary lines inside of property line established by survey as required by Division 1.

B. **Excavation**: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
   1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
   2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

C. **Setting Posts**: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
   1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
      a. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.

D. **Top Rails**: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

E. **Brace Assemblies**: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. **Bottom Tension Wire**: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.

G. **Fabric**: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains under tension after pulling force is released.

H. **Tension or Stretcher Bars**: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.

I. **Tie Wires**: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
   1. Maximum Spacing: Tie fabric to line posts, rails and braces at 12 inches o.c.

J. **Fasteners**: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

**END OF SECTION**

# DIVISION 33 - UTILITIES


| | |
|---|---|
| Section 33 0500 | Common Work Results for Utilities |
| Section 33 1100 | Potable Water Systems |
| Section 33 3100 | Sanitary Sewage Systems |
| Section 33 4000 | Storm Drainage |

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**SECTION 330500**

**COMMON WORK RESULTS FOR UTILITIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. PVC: Polyvinyl chloride plastic.

D. DI: Ductile Iron pipe

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Solvent Cements for Joining Plastic Piping:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:

   1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
   2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Cascade Waterworks Mfg. Co.
      b. Dresser, Inc.; DMD Div.
      c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.

   3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Spears Manufacturing Co.

   3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

E. Plastic-to-Metal Transition Unions:

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Colonial Engineering, Inc.

b. NIBCO INC.
c. Spears Manufacturing Co.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities.

G. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## 2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Hart Industries, International, Inc.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Div.

3. Description: Factory fabricated, union, NPS 2 and smaller.

a. Pressure Rating: 150 psig minimum.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.

c. Epco Sales, Inc.
d. Watts Water Technologies, Inc.

3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

a. Pressure Rating: 175 psig minimum.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

a. Pressure Rating: 150 psig minimum.
b. Gasket: Neoprene or phenolic.
c. Bolt Sleeves: Phenolic or polyethylene.
d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

a. Pressure Rating: 300 psig at 225 deg F
b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation.

b. Precision Plumbing Products, Inc.
c. Victaulic Company.

3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded or grooved.

## 2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

## 2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

## 2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.
2. Density: 115- to 145-lb/cu. ft.
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: 100 to 200 psig at 28 days.

# PART 3 - EXECUTION

## 3.1 PIPED UTILITY DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

## 3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12: Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples or nipples.
2. NPS 2-1/2 to NPS 4 : Dielectric nipples.
3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
4. NPS 10 and NPS 12: Dielectric flange kits.

## 3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

## 3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

## 3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

## 3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

## 3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

## 3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
   1. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping. Place direct bury marker 12-18 inches above top of pipe but not less than 12-inches below finish grade.

## 3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

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**SECTION 331100**

**WATER UTILITY PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
2. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain required permits and inspections.
3. NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for Installation of Private Fire Service Mains and Their Appurtenances".
4. Local Fire Department/Marshall Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections.
5. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service", and are listed by UL.

1.2 SUMMARY

A. This Section includes pressure water pipes and fire systems outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Pipes and valves.
3. Fire Hydrants.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. DI: Ductile Iron pressure pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Pressure Rating: 175 psi static water pressure for all pipes and fittings. Pipe joints shall be water tight.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Fire hydrants
3. Valves.
4. Valve boxes and appurtenances.
5. Pipes.
6. Disinfection reports and practices
7. Product Data: Submit manufacturer's technical product data and installation instructions for fire water system materials and products.
8. Maintenance Data: Submit maintenance data and parts lists for fire water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual.

B. Shop Drawings: For the following:

1. Thrust Blocks: Include plans, elevations, sections, details, and forces for thrust blocks for each size of pipe and type of bend.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping and sewer system piping. Indicate interface and spatial relationship between piping and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

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

## 1.7 PROJECT CONDITIONS

A. Interruption of Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.

2. Line Markers:
   a. Allen Systems Inc.
   b. Seton Name Plate Corp.
   c. Engineer Approved Equal.
3. Pipe Strainers:
   a. "Automatic" Sprinkler Corp. of America; Div. A-T-O Inc.
   b. Cleveland Gear Co.; Sub of Vesper Corp.
   c. Grinnell Fire Protection Systems Co., Inc.
   d. Hersey Products Inc.; Hersey Div.
   e. Mueller Steam Specialty; Div. of Core Industries Inc.
   f. Neptune Water Meter Co.
   g. Rockwell International Corp.; Municipal & Utility Div.
   h. Rockwood Systems Corp.
   i. Zurn Industries Inc.; Fluid Handling Div.
4. Detector Meter: Not Required
5. Gate Valves:
   a. American Valve Mfg. Corp.
   b. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   c. Clow Corp.; Valve Div.
   d. Dresser Mfg. Div. of ITT Grinnell Valve Co. Inc.
   e. Fairbanks Co.
   f. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   g. Stockham Valves & Fittings Inc.
   h. United Brass Works Inc.
   i. United States Pipe and Foundry Co.
   j. Waterous Co.
6. Check Valves:
   a. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   b. Clow Corp.; Valve Corp.
   c. Fairbanks Co.
   d. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   e. Mueller Co.
   f. Nibbco Inc.
   g. Stockham Valves & Fittings Inc.
   h. Walworth Co.
   i. Waterous Co.
7. Yard Hydrants
   a. Josam Mfg. Co.
   b. Smith (Jay R.) Mfg. Co.
   c. Zern Industries, Inc.; Hydromechanics Div.
8. Fire Hydrants: Approved by authority having jurisdiction.
9. Backflow Preventors: Approved by authority having jurisdiction.

## 2.2 IDENTIFICATION

A. Underground –Type Plastic Line Markers: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

B. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".

## 2.3 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

B. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one type of materials or products are indicated, selection is Installer's option.

C. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

D. Ductile Iron Pipe: Polyethylene wrapped Ductile Iron Class 350, with cement mortar lining complying with AWWA C104.
   1. Fitting: Ductile iron AWWA C110; cement lined AWWA C104; and rubber-gasket joints, AWWA C111.

E. Copper Tube: ASTM B 88; type K, soft-annealed temper (for 3/4" to 2" diameter pipe).

F. PVC Pipe: AWWA C900 Class 200 Pipe for gasketed joints and using ASTM F 477, elastomeric seals.

   1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
   2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

## 2.4 WATER METER

A. Water Meter, Meter Set and lid will be provided by water purveyor after payment of connection fees.

B. Contractor to supply concrete meter box and accessories needed to make installation of water meter.

## 2.5 VALVES

A. Gate Valves: UL-listed, 175 psi working pressure for 12" and smaller, 150 psi for sizes larger than 12". Threaded, flanged, hub, or other end configurations to suit size of valve and piping

connection. Inside screw type for use with indicator post, iron body bronze mounted, non- rising stem, solid wedge disc.

B. Check Valves: UL-listed, 175 psi working pressure for 2" through 12", 150 psi for sizes larger than 12". Swing type, iron body bronze mounted with metal-to-metal or rubber-faced checks. Threaded, flanged, or hub end, to suit size and piping connections.

## 2.6 FIRE HYDRANT

A. Provide cast-iron body fire hydrants, compression type, opening against pressure and closing with pressure, base valve design, 200 psi working pressure, with 1/4" gage tapping and bronze plug in standpipe, conforming to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants."

B. Features: Provide the following features:
1. Size: 5" valve opening.
2. Direction to Open Hydrant: Left.
3. Size and Shape of Operating and Cap Nuts: Pentagon 1-1/2" point to flat.
4. Hose Nozzles: 2-1/2" National Standard Thread cap and chain.
5. Pumper Nozzles: 5" National Standard Thread cap and chain.
6. Depth of Trench: 4'-6".
7. Connnection to Main: 6" mechanical joint.

## 2.7 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

B. Clamps, Straps, and Washers: Steel, ASTM A 506.

C. Rods: Steel, ASTM A 575.

D. Rod Couplings: Malleable-iron, ASTM A 197.

E. Bolts: Steel, ASTM A 307.

F. Cast-Iron Washers: Gray-iron, ASTM A 126.

G. Thrust Blocks: Concrete, 3,000 psi.

## 2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Thrust Blocks, Hydrant Supports, and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

PART 3 - EXECUTION

3.1 Examination: Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 EARTHWORK

A. Excavation trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 INSTALLATION

A. Identification: During back-filling/top-soiling of underground fire water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. If pvc pipe is used, install a tracer wire along the top of the pipe, secured with tape, and extending to fire hydrants and valves.

B. Pipe and pipe fittings:
   1. Pipe: Install in accordance with AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances".
   2. Depth of Cover: Provide minimum depth of cover over underground piping in accordance with NFPA 24, Figure A-8-11 "Recommended Depth of Cover Above Top of Underground Yard Mains" or 60" below finish grade, whichever is greater.

C. Piping Specialties:
   1. Pipe Line Strainers: Install as indicated, with valved blowoff piped to drain.

D. Meters: Install as indicated with shutoff valve on either side of meter and valved bypass full line size.

E. Valves: Provide post indicator for control valves.
   1. Shutoff Valves: Install shutoff valve ahead of each hydrant.

F. Hydrants: Install fire hydrants in accordance with AWWA M17 "Installation, Operation, and Maintenance of Fire Hydrants".
   1. Location: Install fire hydrants minimum of 40'-0" from building outside wall, as indicated, or if not shown.
   2. Face hydrants towards drive.
   3. Place hydrants so that base of hydrant is even to 6-inches above adjacent top back of curb.

3.4 PIPING APPLICATIONS

A. Pipe:
   1. Ductile Iron Pipe: Install in accordance with AWWA C600 "standard for installation of ductile-iron water mains and their appurtenances" and in accordance with instructions from water purveyor.
   2. Copper Tube: Install in accordance with CDA "Copper Tube Handbook".
   3. PVC Pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

B. Depth of Cover: Provide minimum cover over piping of 12" below average local frost depth or 42" below finished grade, whichever is greater.

C. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from water Purveyor.

D. Water Service Termination: Terminate potable water piping 5'-0" from building foundation in location and invert as indicated. Provide temporary pipe plug for piping extension into building.
   1. Mark location with surface marker.

## 3.5 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground water pipes. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

C. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

D. Install piping according to the following:

   1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   2. Install piping with line and grade as indicated or below frost line if not inidcated.
   3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
   4. Install ductile-iron special fittings according to AWWA C600.
   5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
   6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

## 3.6 INSTALLATION OF VALVES

A. Install valves with stems pointing up. Provide valve box over underground valves.

## 3.7 INSTALLATION OF WATER METER AND VAULT

A. Install Water Meter and Vault to comply with City Water Department Standards.

## 3.8 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

C. Join dissimilar pipe materials with pressure-type couplings.

## 3.9 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24-hrs prior to testing, and apply test pressure to stabilize system.

B. Hydrostatic Tests: Test at not less than 200 psi for 2-hrs, or at 50 psi above maximum static pressure if it is greater than 150 psi.
1. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints irrespective of pipe diameter.
2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

C. Operating Tests: Open and close all valves and hydrants under system water pressure. Check dry barrel hydrants for proper drainage.
1. For systems with fire pumps, run pumps during operating tests.

## 3.10 ADJUSTING AND CLEANING

A. Disinfection of Potable Water System: Flush pipe system with clean potable water until no dirty water appears at point of outlet. Fill system with water-chlorine solution containing at least 50 ppm of chlorine. Valve off system and let stand for 24- hrs minimum. Flush with clean potable water until no chlorine remains in water coming from system.
1. Repeat procedure if contamination is present in bacteriological examination.

B. Disinfection of Water Mains: Flush and disinfect in accordance with AWWA C651 "Standard for Disinfecting Water Mains".
1. Contractor shall submit written verification to Project Manager stating, Disinfection has been completed in strict compliance with specification for this project and with jurisdiction having authority over water system.

## 3.11 ADJUSTING AND CLEANING

A. Flushing: Flush underground mains and lead-in connections to sprinkler risers before connection is made to sprinklers, standpipes, or other fire protection system piping.
1. Flush at flow rate not less than that indicated in NFPA 24, or at hydraulically calculated water demand rate of the system, whichever is greater.

B. Adjusting: adjust fire hydrants to face street and be have base 2-6 inches above adjacent curb and gutter.

3.12 CLOSING ABANDONED WATER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade according to Division 31 Section "Earth Moving."

END OF SECTION 331100

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# SECTION 33300

# SANITARY SEWERAGE PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Cleanouts.
3. Drains.
4. Precast concrete manholes.
5. Cast in place manhole bases over existing pipes.
6. Sewerage Pipes.

### 1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

### 1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Sewer-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least water tight under specified head, unless otherwise indicated.

### 1.5 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Cleanout materials.
3. Pipes.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 60 feet and vertical scale of not less than 1 inch equals 8 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.
3. If shutdown will affect city streets, other city utilities, or city sewer line, do not proceed without approval from city.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include local pre-cast manufacturers but are subject to approval of the engineer and architect.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.4 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

## 2.5 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150 for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

D. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T 2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

E. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

## 2.6 NONPRESSURE-TYPE PIPE COUPLINGS

A. Use non-pressure type couplings only when pipes can not be connected together with standard fittings and typical pipe connections such as bell and spigot. If possible, file the end on existing pipes to create spigot type connections to match existing pipe ends for connection to a new bell for an extension of the pipe.

B. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

C. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

D. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.

E. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

F. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.

## 2.7 PRESSURE-TYPE PIPE COUPLINGS **(Not Used)**

A. Reducing or transition, metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined. For pressure pipe, use these couplers when pipes can not be extended using existing pipe connections such as bell and spigots.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.
g. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Couplings: With split sleeve with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

1. Manufacturers:

a. Brico Industries.

2. Sleeve Material: Manufacturer's standard.
3. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
4. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
5. Metal Component Finish: Corrosion-resistant coating or material.

## 2.8 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products.

B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

1. Manufacturers:

a. Dresser, Inc.; DMD Div.
b. EBAA Iron Sales, Inc.
c. JCM Industries.
d. Smith-Blair, Inc.

## 2.9 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

a. Josam Company.
b. MIFAB Manufacturing, Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Watts Industries, Inc.
f. Watts Industries, Inc.; Enpoco, Inc. Div.
g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Light, Medium, Heavy, and Extra-heavy duty depending on location and expected driving load on cleanout.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Place in grey iron housing with clamping device and round, secured, scoriated, gray-iron cover.

1. Manufacturers:
a. Canplas Inc.
b. Josam Company
c. MIFAB Manufacturing, Inc.
d. Wad Div.; Tyler Pipe
e. Watts Industries, Inc.
f. Zern Industries, Inc; Zern Specification Drainage Operation
g. IPS Corporation.
h. NDS Inc.
i. Plastic Oddities, Inc.
j. Sioux Chief Manufacturing Company, Inc.
k. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.

## 2.10 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated and as needed for pipe sizes.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 9-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Not used.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing manhole frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

B. Cast-in-Place Concrete Manholes Base: Construct of reinforced-concrete bottom according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
    1. Ballast: Increase thickness of concrete, as required to prevent flotation.
    2. Excavate around existing pipe where manhole is to be placed.
    3. Place new pipe stub at line and grade and stubbed into new manhole location with pipe extending towards existing pipes.
    4. Place CMU blocks or other approved support adjacent to pipes to support new barrel section.
    5. Set first barrel section on CMU blocks and verify that barrel section is level in all directions and is not sitting on pipes.
    6. Make sure that hole is deep enough that the depth of concrete will be 9-inches below existing and new pipes.
    7. Place concrete around barrel section and inside barrel section so that the existing and new pipes are at least 50% covered with concrete.
    8. Hand form trough as needed.
    9. Let concrete cure and break out of pipes for trough. Grout all troughs smooth and even with pipes.
    10. Stack remaining barrel sections and add cone, ring and cover etc. as indicated for precast manhole.

## 2.11 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

    1. Cement: ASTM C 150, Type II.
    2. Fine Aggregate: ASTM C 33, sand.
    3. Coarse Aggregate: ASTM C 33, crushed gravel.
    4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

    1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
    2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

    1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
    2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Flexible or rigid couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints. **(Not Used)**

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:
1. PVC sewer pipe and fittings; gaskets; and gasketed joints.
2. Ductile-iron pressure pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
3. PVC pressure, PVC pressure fittings, gaskets, and gasketed joints.

D. Force-Main Pressure Piping: Use any of the following pipe materials for each size range: **(Not Used)**

1. PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
2. Ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
3. PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at slope indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction for pressure pipe. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with cover indicated.
4. Notify engineer of clearance problems that would result in changes to grade and alignment.
5. Install ductile-iron culvert piping according to ASTM A 716.
6. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Install force-main pressure piping according to the following: **(Not Used)**

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with line and grade as indicated or below frost line if not inidcated.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

## 3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
3. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.
4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
5. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
6. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

C. Join force-main pressure piping according to the following: **(Not Used)**

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

D. Join dissimilar pipe materials with pressure-type couplings.

## 3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use same pipe type as sewer line that the cleanout is connected to. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 inches around outside of cover. At contractors option, a square block can be used that is at least 12-inches wider that the cover. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

## 3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manhole bases as indicated.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

## 3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

## 3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary sewer system.

B. Connect force-main pressure piping to building's force mains where indicated. **(Not Used)**

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

## 3.9 CLOSING ABANDONED SEWER DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

## 3.10 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

## 3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.
f. Test for infiltration or exfiltration between manholes as follows:
1) Clean section of sewer line of dirt. Debris, gravel, rocks and other items.
2) Fill section between manholes with water. Allow water to sit in pipe for not less than 3-hours to acclimate to surrounding earth temperature.

3) Use a water pump to pressurize the sewer pipe section to not less than 5 psi and not more than 10 psi. Record starting pressure.
4) Turn off water pressure and wait 20 minutes.
5) Refill pipe to same pressure as in step 3 and measure volume required to fill pipe to same pressure.
6) Pipe section passes test if volume required to refill pipe is less than ½-gallon per 400 feet of 8-inch pipe. Prorate the allowable seepage larger or smaller pipes and for shorter or longer distances.
7) Find and fix leaks in any section that fails to pass test. Fix any visible leaks found even if section of pipe passes test.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Test pressure piping to same standard as water pipes in section 331100. **(Not Used)**
1. Leaks and loss in test pressure constitute defects that must be repaired.
2. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

## 3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 333100

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# SECTION 334100

# STORM UTILITY DRAINAGE PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Cleanouts.
3. Drains.
4. Precast concrete manholes, inlet boxes, catch basins.
5. Cast in place inlet boxes and catch basins and manhole bases over existing pipes.

### 1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. CP: Non-reinforced concrete pipe.

C. RCP: Reinforced concrete pipe.

### 1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

### 1.5 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Drains.
3. Storage.
4. Pipes.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Field quality-control test reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

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

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

## 1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of service. Coordinate interruptions during weekly meetings and at pre-construction meeting.
2. Do not proceed with interruption of service without Architect's, Construction Manager's, and Owner's written permission.

# 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include local pre-cast manufacturers but are subject to approval of the engineer and architect.

## 2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

## 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.4 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

## 2.5 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150 for gasketed joints and using ASTM F 477, elastomeric seals.

1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 35, socket-type fittings for solvent-cemented joints.

D. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

E. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T 2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

F. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

## 2.6 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14, Class I, II or III, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

B. Piping in paragraph below is available in 5 classes and 3 wall thicknesses, and in NPS 12 to NPS 144. Not all classes and wall thicknesses are available. Joints are gasket type. Contractor, at his option, may use non-reinforced pipe for sizes up to 21-inches if structural requirements based on load on pipe are not exceeded for that pipe. If reinforced pipe is selected, choose the pipe class and wall thickness to suit availability and structural requirements based on loads and cover.

C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

1. Class I
2. Class II
3. Class III

## 2.7 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.

D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.

## 2.8 PRESSURE-TYPE PIPE COUPLINGS

A. Reducing or transition, metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.
g. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Couplings: With split sleeve with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

1. Manufacturers:

a. Brico Industries.

2. Sleeve Material: Manufacturer's standard.
3. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
4. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
5. Metal Component Finish: Corrosion-resistant coating or material.

## 2.9 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products.

B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

1. Manufacturers:

a. Dresser, Inc.; DMD Div.
b. EBAA Iron Sales, Inc.
c. JCM Industries.
d. Smith-Blair, Inc.

## 2.10 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

a. Josam Company.
b. MIFAB Manufacturing, Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Watts Industries, Inc.
f. Watts Industries, Inc.; Enpoco, Inc. Div.
g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Light, Medium, Heavy, and Extra-heavy duty depending on location and expected driving load on cleanout.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Place in grey iron housing with clamping device and round, secured, scoriated, gray-iron cover.

1. Manufacturers:

a. Canplas Inc.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.

## 2.11 DRAINS

A. Gray-Iron Area Drains: ASME A112.21.1M, round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Manufacturers:

   a. Josam Company.
   b. MIFAB Manufacturing, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   f. Watts Industries, Inc.; Enpoco, Inc. Div.
   g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.

2. Top-Loading Classification(s): Medium and heavy duty depending on location and expected driving load.

B. Gray-Iron Trench Drains: ASME A112.21.1M, 6-inch to 12-inch-wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Manufacturers:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Wade Div.; Tyler Pipe.
   d. Watts Industries, Inc.
   e. Watts Industries, Inc.; Enpoco, Inc. Div.
   f. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
   g. Poly Drain, ABT

2. Top-Loading Classification(s): Medium, heavy, and extra-heavy duty.

## 2.12 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated and as needed for pipe sizes.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 9-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Not used.

9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing manhole frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
3. Steps: Not used.
4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

    a. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48, Class 35 gray iron, unless otherwise indicated and to match existing frames and covers.
    b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.

## 2.13 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.14 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

A. Description, General: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include number of units required to form total lengths indicated.

B. Manufacturers:

1. ABT, Inc.
2. ACO Polymer Products, Inc.
3. Innovative Plastics Products. Inc.
4. Mea-Josam Div.; Josam Company.
5. Strongwell; Lenoir City Div.

C. Sloped-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include inside width and depth as indicated with rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.

   a. Frame: Include gray-iron or steel frame for grate.

2. Grates with manufacturer's designation "Heavy Duty," with slots or perforations that fit recesses in channels.

   a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Narrow-Width, Level-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include 5-inch inside width and 9-3/4-inch deep, rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
2. Grates with slots or perforations that fit recesses in channels.

   a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

E. Wide-Width, Level-Invert, Polymer-Concrete Systems: Include the following components:

1. Channel Sections: Interlocking-joint, precast, modular units with end caps. Include 8-inch inside width and 13-3/4-inch-deep, rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
2. Grates with slots or other openings that fit recesses in channels.

a. Material: Gray iron.

3. Covers: Solid gray iron, if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

F. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

G. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

## 2.15 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
3. Top Section: Flat-slab-top type with hole for frame and grate is indicated.
4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match frame and grate.
7. Steps: Not Used.
8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section. Size sections and box or manhole to fit pipes without necesary

B. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.
2. Channels and Benches: Concrete.
3. Steps: Not used.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small, square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

## 2.16 STORMWATER INLETS

A. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates. All grates to be bicycle safe.

B. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

2.17 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregular size and shape, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size, graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

2.18 DRY WELLS **(Not Used)**

A. Description: ASTM C 913, precast, reinforced, perforated concrete manholes with ring and cover, frame and grate, or lid as indicated and include the following:

1. Floor: Cast-in-place concrete support ring.
2. Cover: Liftoff-type concrete cover with cast-in lift rings.
3. Wall Thickness: 4 inches minimum with 1-inch diameter or 1-by-3-inch maximum slotted perforations arranged in rows parallel to axis of ring.

   a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
   b. Ring Construction: Designed to be self-aligning.

4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

   a. Flexible or rigid couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:

1. PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
2. PVC sewer pipe and fittings; gaskets; and gasketed joints.
3. Class [1] [2] [3], nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
4. Ductile-iron culvert pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
5. Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
6. Corrugated steel pipe and fittings, standard and special-joint bands, and banded joints.
7. Corrugated aluminum pipe and fittings, standard and special-joint bands, and banded joints.
8. Corrugated PE pipe and fittings, silttight couplings, and coupled joints.

D. Force-Main Pressure Piping: Use the following pipe materials for each size range: **(Not Used)**

1. PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
2. Ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
3. PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

## 3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at slope indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction for pressure pipe. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with cover indicated.
4. Notify engineer of clearance problems that would result in changes to grade and alignment.
5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron culvert piping according to ASTM A 716.
7. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
8. Install corrugated steel piping according to ASTM A 798/A 798M.
9. Install corrugated aluminum piping according to ASTM B 788/B 788M.
10. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
11. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
14. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install force-main pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with line and grade as indicated or below frost line if not inidcated.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23 or ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

## 3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
3. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
4. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
5. Join corrugated PE piping according to CPPA 100 and the following:

   a. Use silttight couplings for Type 1, silttight joints.

6. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.

7. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
8. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
9. Join nonreinforced-concrete sewer piping according to ASTM C 14and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
10. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
11. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.

C. Join force-main pressure piping according to the following: **(Not Used)**

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

D. Join dissimilar pipe materials with pressure-type couplings.

## 3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use same pipe type as sewer line that the cleanout is connected to. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 inches around outside of cover. At contractors option, a square block can be used that is at least 12-inches wider that the cover. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

## 3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use light-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification drains in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification drains in roads areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

## 3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

## 3.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

C. Align boxes so that frame and grates are square to adjacent sidewalks, curbs or roadways.

## 3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

## 3.10 DRY WELL INSTALLATION **(Not Used)**

A. Excavate hole to diameter of at least 24 inches greater than outside of dry well. Do not extend excavation into ground-water table.

1. Install filter fabric as indicated. Provide sufficient filter fabric to lap sliced areas at least 12-inches.

B. Install precast, concrete-ring dry wells according to the following:

1. Assemble rings to depth indicated.
2. Extend rings to height where top of cover will be approximately 8 inches below finished grade.

3. Backfill bottom of inside of rings with filtering material to level at least as indicated on plans.
4. Extend effluent inlet pipe 12 inches into rings and terminate into side of tee fitting.
5. Backfill around outside of rings with filtering material to top level of rings and to depth indicated.
6. Install cover over top of rings.

## 3.11 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

## 3.12 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

D. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

E. Fasten grates to channel sections if indicated.

F. Assemble channel sections with flanged or interlocking joints.

G. Embed channel sections in 4-inch minimum concrete around bottom and sides.

## 3.13 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Connect force-main pressure piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

## 3.14 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

## 3.15 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

## 3.16 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924.

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig

    a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.17 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

**END OF SECTION 334100**

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