

AUGUST 16, 2023

WTA ARCHITECTS



# MIDLAND COUNTY ESA

MIDLAND, MICHIGAN

ARCHITECT'S PROJECT NO. 2022006.1

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DOCUMENT 003126 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A geotechnical investigation report for Project, prepared by Intertek PSI, dated April 4, 2023, is available for viewing as appended to this Document.

END OF DOCUMENT 003126



Professional Service Industries, Inc.  
3120 Sovereign Drive, Suite C  
Lansing, Michigan 48911  
Phone: (517) 394-5700

April 14, 2023

Mr. Thom Laney, Senior Project Manager  
**Three Rivers Corporation**  
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Midland, MI 48642  
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**RE: Geotechnical Exploration and Engineering Report**  
Proposed Midland County ESA Building Addition and Renovation  
3917 Jefferson Avenue  
Midland, Michigan  
PSI Report **No. 0406-926**

Dear Mr. Laney:

As requested, PSI has developed a geotechnical engineering report for the referenced project. The results of this exploration, together with our recommendations, are presented in the accompanying report, a copy of which is being transmitted herewith.

After plans and specifications are complete, PSI should review the final design and specifications to verify that the earthwork and pavement recommendations are properly interpreted and implemented. **It is considered imperative that the geotechnical engineer and/or its representative be present during earthwork operations and pavement installations to observe the field conditions with respect to the design assumptions and specifications.** PSI will not be responsible for interpretations and field quality control observations made by others. Scheduling for our nearest Construction Materials Testing and Inspection location in Lansing, Michigan is available at (517) 394-5700.

PSI appreciates the opportunity to provide geotechnical engineering and consulting services for your project and looks forward to working with you during the construction phase. PSI provides additional services, which include construction materials testing and observation services, environmental services, roof consulting and observation services, pavement and asphalt testing services and specialty engineering and testing. If you have any questions regarding this report, or if we may be of further service, please feel free to contact this office at your convenience.

A handwritten signature in black ink, reading "Taha Khalaff". The signature is written in a cursive style and is enclosed within a dashed rectangular box.

Taha Khalaff, Ph.D., P.E.  
Senior Geotechnical Engineer  
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A handwritten signature in blue ink, reading "Jeffrey D. Hestwood". The signature is written in a cursive style and is enclosed within a dashed rectangular box.

Jeffrey D. Hestwood, P.E.  
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**GEOTECHNICAL EXPLORATION  
AND ENGINEERING REPORT**

**FOR THE:**

**PROPOSED MIDLAND COUNTY ESA BUILDING  
ADDITION AND RENOVATION  
3917 JEFFERSON AVENUE  
MIDLAND, MICHIGAN**

**PREPARED FOR:**

**THREE RIVERS CORPORATION  
3069 VANTAGE POINT DRIVE  
MIDLAND, MI 48642**

**PREPARED BY:**

**PROFESSIONAL SERVICE INDUSTRIES, INC.  
3120 SOVEREIGN DRIVE, SUITE C  
LANSING, MICHIGAN 48911**

**APRIL 14, 2023**

**PSI PROJECT NO. 0406-926**

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## **PROJECT INFORMATION**

### **Project Authorization**

This engineering report presents the results of our geotechnical engineering exploration performed relative to the proposed Midland County ESA Building Addition and Renovation will be located at 3917 Jefferson Avenue in the City of Midland, Midland County, Michigan.

This exploration was performed for Three Rivers Corporation in accordance with PSI Proposal No. 0406-391567 dated January 30, 2023. Authorization to perform this exploration and analysis was in the form of acceptance of PSI's proposal by Mr. Thom Laney, Senior Project Manager of Three Rivers Corporation on February 17, 2023.

### **Project Description**

Project information was provided by Mr. Thom Laney, Senior Project Manager of Three Rivers Corporation, via email on January 23, 2023. The correspondence included the following:

- Request For Proposal
- Proposed Building Addition Plan with proposed boring locations entitled "Addition, Sheet No. A2.15" prepared by WTA Architect dated January 2023.

Briefly, PSI understands that Three Rivers Corporation is planning to construct a new building addition located at existing Midland County ESA facility that located at 3917 Jefferson Avenue in the City of Midland, Midland County, Michigan. The proposed building will be a single-story addition adjacent to the south side of the existing building with concrete slab on grade and no basement. PSI anticipate that the building addition will be steel/wood framed with masonry bearing walls and brick veneer. Wall and column loads were not provided by the client. For the purposes of our analysis, PSI estimates that the maximum design column loads will be 60 kips, and the maximum design wall loads will be 4 kips per lineal foot.

The finished floor elevation was not provided. For the purposes of our analysis PSI estimates that the finished floor elevation will match the finished floor elevation of the existing building estimated to be approximately 624 feet. Based on the existing topography, PSI anticipates approximately +/- 2 feet of cut/engineered fill will be required to achieve the proposed building's finished floor elevation(exclusive of any additional cut/fill associated with removal of unsuitable soil sections).

The geotechnical recommendations presented in this report are based on the available project information and results of our geotechnical exploration. If any of the noted information is considered incorrect or is changed, please inform PSI in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project. PSI should be consulted once the structure design has been finalized. Additional subsurface investigation may need to be performed by PSI at that time.



## **Purpose and Scope of Services**

The purpose of this exploration was to evaluate the subsurface conditions at the site and to develop geotechnical design criteria for support of foundations for the planned project. The scope of the exploration and analysis included a reconnaissance of the project site, completion of seven (7) soil borings, field and laboratory testing of representative portions of the recovered samples, and engineering analysis and evaluation of the subsurface materials encountered.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands, hazardous or toxic materials in the soil, bedrock, surface water, groundwater or air on, below or around this site. Any statement in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. Prior to the development of any site an environmental assessment is advisable.

As directed by the scope of work provided by Three Rivers Corporation. PSI did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. Three Rivers Corporation acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Three Rivers Corporation further acknowledges that site conditions are outside of PSI 's control and that mold amplification will likely occur or continue to occur in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

PSI also provides an array of complementary environmental and industrial hygiene services to assist our clients in successfully assessing and developing properties such as the one referenced in this report. PSI's environmental consultants apply their experience, local geologic knowledge and thorough understanding of ASTM standards, environmental risk, and regulatory knowledge to conduct due diligence assessments of a wide range of property types and proposed developments.

## **SITE AND SUBSURFACE CONDITIONS**

### **Site Location and Description**

The project site is located at 3917 Jefferson Avenue in the City of Midland, Midland County, Michigan. The project site consists of green landscape and asphalt pavement and is surrounded by residential and commercial development. The project site boundaries are Midland County ESA Building to the north, Jefferson Avenue to the east, Residential buildings and green space area and trees to the west, and Green space areas, and trees to the south. The general site location is shown on the site location diagram in the Appendix as Figure No. 1.

The terrain across the project site was relatively level with grades varying on the order of approximately  $\pm 3$  feet, according to Google Earth Pro. The ground surface of the project site was firm at the time of the field services as indicated by the fact that the drilling rigs experienced little difficulty in accessing the boring locations.





## Field Exploration and Laboratory Testing

The site subsurface conditions were determined by completion of seven (7) soil test borings located within or near the proposed building addition footprint area. All soil borings were advanced to a depth of approximately 25 feet below the existing ground surface. The boring locations and depths of the borings were established by Three Rivers Corporation and were located and marked in the field by PSI by measuring from existing site features indicated on the concept plan provided by Three Rivers Corporation. The approximate boring locations are depicted on the Boring Location Diagram included in the Appendix.

The soil borings were performed on March 15 and 16, 2023, by means of a CME-55 truck-mounted drilling rig equipped with a rotary head utilizing 3¼ inch hollow-stem augers to advance the boreholes. Representative soil samples were recovered employing split-barrel sampling procedures in general accordance with "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D1586). After completion of the test borings the holes were backfilled with the excavated soils.

Determination of the ground surface elevations by survey at the test boring positions was not within the scope of PSI's services. The approximate ground surface elevations at the boring locations were obtained by PSI from Earth Pro. Prior to final design and construction, field measurement at the boring locations should be made by a professional land surveyor registered in the State of Michigan. References to depths in this report and on the attached Boring Logs are from the existing ground surface unless otherwise noted.

In addition to the field exploration, a laboratory-testing program was conducted to evaluate engineering characteristics of the subsurface materials. The laboratory-testing program included visual classification and moisture content tests on all the material recovered. The unconfined compression strength of the cohesive soils encountered was estimated utilizing a calibrated hand penetrometer. The results of these tests are located on the boring logs which are included in the Appendix. The laboratory testing program was conducted in general accordance with applicable ASTM specifications. The unused portion of the soil samples will be placed in storage at PSI's Lansing, Michigan facility. Unless otherwise requested in writing, the samples will be discarded after 60 days from the submission of the final report.

## Subsurface/Surface Conditions

At the time of our field exploration, the surface and subsurface conditions encountered at the project site can be described in the following table:

| <b>Table 1: Existing Surface/Subsurface Summary</b> |                     |  |                                |
|---|---------------------|--|--------------------------------|
| <b>Soil Boring</b>                                  | <b>Depth (feet)</b> | <b>Surface Material and Thickness</b>                      | <b>Major Native Strata</b>     |
| <b>SB-01</b>  | 25                  | 4" Topsoil<br>3'2" Sandy Clay (Base)<br><i>Total: 3.5'</i> | Light Reddish Brown SILTY CLAY |



| <b>Table 1: Existing Surface/Subsurface Summary</b> |                     |  |   |
|---|---------------------|--|---|
| <b>Soil Boring</b>                                  | <b>Depth (feet)</b> | <b>Surface Material and Thickness</b>                      | <b>Major Native Strata</b>  |
| <b>SB-02</b>  | 25                  | 5" Topsoil   | Light Reddish Brown SILTY CLAY  |
| <b>SB-03</b>  | 25                  | 5" Topsoil   | Yellowish Brown fine to medium SAND<br>Light Reddish Brown SILTY CLAY |
| <b>SB-04</b>  | 25                  | 6" Topsoil   | Light Gray fine SILTY SAND<br>Light Reddish Brown SILTY CLAY          |
| <b>SB-05</b>  | 25                  | 6" Topsoil   | Light Gray fine SILTY SAND<br>Light Reddish Brown SILTY CLAY          |
| <b>SB-06</b>  | 25                  | 5" Topsoil   | Yellowish Brown fine to medium SAND<br>Light Reddish Brown SILTY CLAY |
| <b>SB-07</b>  | 25                  | 5" Topsoil<br>3'1" Sandy Clay (Base)<br><i>Total: 3.5'</i> | Light Reddish Brown SILTY CLAY  |

At the time of our field exploration, the surface of each soil boring location consisted of topsoil layer ranging between approximately 4 and 8 inches in thickness. Directly below the topsoil layer at soil boring locations SB-01 and SB-07, apparent old fill material composed of sandy clay with variable percentage of silt, gravel, and organics, was encountered. The apparent old fill materials extended to a depth of approximately 3.5 feet below the existing ground surface. Native soils were encountered below the topsoil layer and apparent fill soil at all boring locations which generally may be characterized as sand and clay as described in the following paragraphs.

**Yellow/Brown/Gray Sand:** A stratum of native light gray and yellowish brown fine to medium sand and fine silty sand with variable percentages of clay and gravel, was encountered below the topsoil at soil Borings SB-03 through SB-06 and extended to depths ranging between approximately 3.5 and 6 feet below the existing ground surface. The Standard Penetration Test values (N values) of the granular strata ranged from 2 to 8 blows per foot, indicating a very loose to loose relative densities. The moisture contents of the tested sand samples ranged from 19 to 33 percent. The samples visually appeared to be in wet condition when examined in the laboratory.

**Reddish Brown Clay:** was predominantly silty in composition with variable percentages of fine sand. The clay soil was encountered directly below the topsoil at soil boring SB-02, below apparent the old fill material at soil borings SB-01 and SB-07, and below the sand stratum at remaining soil borings. The silty clay stratum extended to the maximum depth of exploration of approximately 25 feet below the existing ground surface. The moisture contents of the tested clay samples ranged between 16 and 32 percent. Visually, the samples appeared in wet condition when examined in the laboratory. Standard Penetration Test (SPT) values (N values) from within the clay layers ranged between 2 and 14 blows per foot. Unconfined compressive strength values estimated using a hand penetrometer ranged between 1 and 2 TSF indicating firm to stiff consistencies.



Cobbles and/or boulders were not encountered during drilling operations. The boring logs should be referenced with respect to this information. The presence of boulders and cobbles in the profile is a result of the geologic method of deposition of the soil materials at this site. Even where cobbles or boulders were not noted within the profile they could be encountered between the boring positions. The Contractor should be equipped for this condition.

The above subsurface descriptions are of a generalized nature and are provided to highlight the major soil strata encountered. The Boring Logs included in the Appendix should be reviewed for specific information as to individual boring locations. The stratification shown on the Boring Logs represents the conditions encountered at the specific boring locations. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials; however, the actual transition may be gradual, abrupt, or not clearly defined. In the absence of foreign substances or debris, it is often difficult to distinguish between native soils and clean fill soil.

### **Groundwater Information**

Free groundwater was not encountered during drilling operations nor upon completion of soil exploration at any soil boring. Collapse of the soils above groundwater (i.e. "dry cave") was not observed during drilling operations. However, saturated to nearly saturated conditions were observed within the recovered soil samples at all Boring locations at and below a depth of approximately 3.5 feet below existing ground surface. The Boring Logs included in the Appendix should be reviewed for specific information as to depths of groundwater and dry caves.

Groundwater levels on this site are likely to vary because of seasonal conditions and fluctuations should be anticipated. Groundwater quantities and flow volumes will largely depend on the permeability of the soil profile. It is recommended that the contractor determine the actual groundwater levels at the time of the construction to evaluate groundwater impact on construction procedures.

### **Site Seismic Classification**

Midland County in Michigan lies in the Central Stable Tectonic Region and in Seismic Zone area 0 of probable seismic activity of the Building Officials Congress of America (BOCA), National Building Code, and the Uniform Building Code (UBC). This zone indicates that minor damages due to occasional earthquakes might be expected in this area.

In the 2015 Michigan Building Code (MBC), the State of Michigan has adopted the provisions of the International Building Code (IBC). The Site Class is based on a weighted average of known or estimated soil properties for the uppermost 100 feet of the subsurface profile. Soil borings at the project site extended to a maximum depth of approximately 25 feet below the existing ground surface. Based on the regional geologic mapping, as well as data available on the Water Well Record Retrieval System of the Department of Environmental Quality in the State of Michigan. Bedrock most likely is part of the Saginaw formation of the Pennsylvanian geologic age, which consists of sandstone, shale, with variable presence of limestone and coal. Based on our review of the available data, knowledge of regional geology and the Standard Penetration Test (SPT) N-values and approximated soil shear strength PSI estimates that the seismic design



for this project, based on the upper 100 feet of the subsurface soil profile would be **Site Class D**.

The 2015 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e., depth of soil and strata types). Based on the depth to rock and the estimated shear strength of the soil at the boring locations, **Site Class "D" is recommended**.

The USGS-NEHRP probabilistic ground motion values near Latitude 43.6324°N, and -84.2278°W are as follows:

| Table 2: USGS-NEHRP Probabilistic Ground Motion Values |  |                   |                                       |   |               |
|--|--|-------------------|---------------------------------------|---|---------------|
| Period (seconds)                                       | 2% Probability of Event in 50 years * (%g) | Site Coefficients | Max. Spectral Acceleration Parameters | Design Spectral Acceleration Parameters |               |
| 0.2 ( $S_s$ )  | 6.1  | $F_a = 1.6$       | $S_{ms} = 0.098$                      | $S_{Ds} = 0.065$                        | $T_0 = 0.187$ |
| 1.0 ( $S_1$ )  | 3.8  | $F_v = 2.4$       | $S_{m1} = 0.092$                      | $S_{D1} = 0.061$                        | $T_s = 0.938$ |

$$\begin{aligned} S_{ms} &= F_a S_s & S_{Ds} &= 2/3 * S_{ms} & T_0 &= 0.2 * S_{D1} / S_{Ds} \\ S_{m1} &= F_v S_1 & S_{D1} &= 2/3 * S_{m1} & T_s &= S_{D1} / S_{Ds} \end{aligned}$$

The Site Coefficients,  $F_a$  and  $F_v$  were interpolated from 2015 IBC Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classification and the mapped spectral response acceleration at the short ( $S_s$ ) and 1 second ( $S_1$ ) periods. The development of shear strains tending to cause liquefaction of sand deposits is governed by the character of the ground motion (i.e. acceleration and frequency), soil type, groundwater level, and in-situ stress conditions. PSI believes the risk of liquefaction occurring at this site is low based on the site being in a low seismic activity area.

## EVALUATION AND RECOMMENDATIONS

### Site Preparation

Prior to site grading activities or excavation for foundation elements, existing underground utilities, and structures, should be identified and rerouted or properly abandoned in-place. Existing underground utilities that are not re-routed or abandoned should be adequately marked and protected to minimize the potential for damage during construction activities.

Undocumented old fill was encountered at the locations of borings SB-01 and SB-07. Topsoil, undocumented fill, and soils containing organics can potentially undergo high and variable volume changes when subjected to loads, resulting in detrimental performance of floor slabs, pavements, structural fills, and shallow foundations placed on them. **Therefore, PSI recommends that topsoil, as well as any old fill soils or apparent old fill soils (if encountered), be stripped from the planned construction areas and under PSI's supervision.**

After the topsoil, old fill soils, and loose/soft soils (if encountered) have been removed from the areas of construction and any cut sections are performed, exposed subgrades should be observed and be thoroughly proof rolled/compacted with a large, heavy rubber-tired vehicle prior to the placement of engineered fill or backfill required to achieve the proposed subgrade elevation. Areas that exhibit



instability or are observed to rut or deflect excessively under the moving load should be further undercut, stabilized by aeration, drying (if wet) and additional compaction to attain a stable finished subgrade. The proof rolling/compacting and undercutting activities should be performed during a period of dry weather and should be performed under the supervision of the geotechnical engineer's representative. Exposed granular subgrades must be compacted to a minimum of 95 percent of the maximum dry density within 3 percent of the optimum moisture content as determined by ASTM D-1557 (Modified Proctor).

Where subgrade conditions are not improved through aeration, drying and compaction, or where undercut and replacement is considered impractical due to the underlying soil conditions, it may be necessary to stabilize localized areas of subgrade instability with a woven geotextile, geogrid and a layer of well graded crushed concrete or well graded coarse aggregate such as MDOT 4AA, 6A or 21AA. The need for the use of geotextile, geogrid and the thickness and gradation requirements of the crushed aggregate layer required should be determined at the time of the subgrade preparation, based on the condition of the exposed subgrade at the time of construction. The subgrade should be stabilized prior to placement of engineered fill or aggregate base course. New engineered fill supporting at-grade structures should be an environmentally clean material, free of organic matter, frozen soil, or other deleterious material. The material proposed to be used as engineered fill should be evaluated and approved for use by a PSI geotechnical engineer or his representative prior to placement in the field.

After the subgrade has been stabilized, any engineered fill required may then be placed. PSI should monitor proper control of the placement and compaction of new fill soils. The new materials must be free of organic matter. Fill materials are to be placed in individual lifts not exceeding 8 inches in loose thickness. Each lift is to be compacted to 95 percent of the maximum dry density within 3 percent of the optimum moisture content as determined in accordance with ASTM Method D-1557 (Modified Proctor). A minimum of one test per 2,000 square feet of building should be performed for each lift, unless otherwise specified by the engineer. The moisture/density relationship (Proctor) of the material to be used as engineered fill should be evaluated by a PSI geotechnical engineer or his representative prior to placement in the field. PSI recommends one Proctor test for every 5,000 cubic yards (cyds) of fill and one test per change of material.

Portions of the old fill and native soils appear to be suitable for re-use as engineered fill provides the soils are free of organics and miscellaneous debris and particle sizes do not exceed 3 inches in diameter. PSI must be on site prior to re-use of the existing native and fill materials to document and verify that these soils are suitable for the intended use as engineered fill. Imported materials to be utilized as structural fill should meet (or be similar to) the requirements of MDOT Class II granular soil. Construction traffic should be restricted from the exposed subgrade to help reduce the potential for loosening of the subgrade soils, particularly where excess moisture is present from groundwater and/or precipitation. PSI recommends that the fill be strategically placed so that the construction equipment remains on newly placed fill soils and not on the exposed subgrade during fill placement.



## Foundation Recommendations

Apparent old fill material was encountered at the locations of Borings SB-01 and SB-07. The apparent old fill material is considered to be unreliable for shallow foundation support. Consequently, PSI recommends these old fill materials be undercut in their entirety from below the foundations under PSI supervision and replaced with new properly compacted engineered fill. Based on the borings performed, the thickness of the fill was approximately 3.5 feet, however, the composition, thickness and required undercut depth of the undocumented fill is likely to vary across the site from that encountered at the individual boring locations performed. In addition, undocumented fill and buried native soils with organics may be present in un-explored areas of the site. The bottoms of the undercut excavations must be evaluated under PSI supervision prior to placement of engineered backfill. Structural fill placement should be performed in accordance with the Site Preparation Section of this report.

Where the removal of localized unsuitable bearing material is performed beneath the proposed footings and the excavation is backfilled with compacted fill materials, the excavation must extend laterally beyond the perimeter of the foundation for a distance equal to one-half of the thickness of the engineered backfill placed below the footing bottom. The over excavation is necessary for proper support of lateral loads exerted through the fill by the foundations.

Care should be taken when excavating adjacent foundations supporting the existing building and the existing floor slab. Temporary earth retention may also be necessary during removal and replacement of the old fill materials.

Following undercutting and replacement of the uncontrolled old fill materials as outlined above (as necessary), the proposed structure may be supported on a conventional shallow foundation system. PSI recommends **a net allowable soil bearing capacity of up to 2,000 pounds per square foot** be used in the design of the foundations where they bear on the native firm to stiff silty clay or properly compacted engineered fill placed over suitable native soils. Following the above recommended bearing capacity value, total settlement is estimated to be on the order of 1 inch with differential settlement less than ½ of the total settlement, provided the following design and construction details are incorporated.

In order to protect against frost action, perimeter footings, exterior footings and footings located in unheated areas must bear at a minimum depth of three and one-half (3 ½) feet below final surface grades. Interior footings not subject to frost action may be founded at a depth of at least eighteen (18) inches below the floor slab, provided that these foundations will be bearing on properly placed engineered backfill or suitable native soil.

Footing supporting individual columns should have a minor dimension of no less than 30 inches and a minimum wall footing width of no less than 18 inches, even if those dimensions result in stresses below the allowable bearing capacity. The purpose of limiting the footing size is to prevent "punching" shear deformation and to provide for vertical stability.



Foundation excavations should be observed and tested by PSI prior placement of formwork or foundation concrete. This is especially important of this site due to the uncontrolled fill and low strength, high moisture content sensitive silty clay soil. Depend on the soil and groundwater conditions at the time of construction, it may be necessary to stabilize the foundation bottoms with crushed stone.

The Structural Engineer should evaluate the need for the proposed new building addition to be structurally independent of the existing building structure to allow independent movement between the existing building and the proposed addition. Where new foundations supporting the proposed building addition are placed adjacent to foundations supporting the existing building structures, they should be placed at the same elevation as the existing footings, if possible, to minimize superposition of loads. Foundations should then be stepped up as necessary at a grade no steeper than two units horizontal to one unit vertical to achieve the elevation of the new foundations.

Where bearing soils are granular in nature, PSI recommends that the foundation inverts be compacted in place by several passes of a vibratory compactor, prior to placement of formwork or cast-in-place foundation concrete, to densify any soils disturbed during excavation as well as to densify the underlying native granular soils. The compaction should continue until no additional densification is observed with additional passes.

In order to reduce the effects of differential movement that may occur due to variations in the character of the supporting soils and variations in seasonal moisture contents, it is recommended that building and wall footings be suitably reinforced.

### **Concrete Slab-on-Grade**

The subgrade soils utilized for the support of slabs-on-grade should be prepared as indicated in the Site Preparation Section of this report. It appears that newly placed engineered fill (emplaced on suitable native soils) will be adequate for support of concrete slabs. If soft, loose or unsuitable fill soils are encountered at the subgrade level, we recommend that these materials be undercut to an adequate depth and replaced with properly compacted granular or low plasticity fill soil. Proof-Rolling, as discussed earlier in this report, should be performed to identify any soft or unsuitable soils, which should then be removed from the floor slab area prior to fill placement and/or floor slab construction.

A granular mat should be provided between the floor slab and the subgrade soil. It should be 4 inches or greater in thickness and be properly compacted as recommended in this report. The granular mat materials should comply with the current version of ACI 302.1.

Slabs should be suitably reinforced to make them as rigid as necessary. Proper joints should be provided at the junctions of the slab and the foundation system so that a small amount of independent movement can occur without causing damage. The floor areas should be provided with joints at frequent intervals to compensate for concrete volume changes during curing. If a vapor retarder/barrier will be utilized, placement should be following the current version of ACI 302.1, local building codes and the recommendations of the flooring manufacturer. **A modulus of subgrade reaction for the native soils (or imported fills) specified and conditioned as described in this report of 100 psi/in may be used for the floor slab design.** This value may be confirmed in the field by performing a 1-foot by 1-foot plate load test. However, depending on how the slab load is applied, the value must be geometrically





modified.

## **CONSTRUCTION CONSIDERATIONS**

### **Drainage and Groundwater Considerations**

Free groundwater was not encountered during drilling operations nor upon completion of soil exploration at any soil boring. However, saturated to nearly saturated conditions were observed within the recovered old fill soil samples at all Boring locations at and below a depth of approximately 3.5 feet below existing ground surface. Therefore, difficulty with groundwater seepage and subgrade instability may be anticipated during earthwork, foundation excavation and construction associated with the proposed project. It is possible for the groundwater table to vary within the depths explored during other times of the year depending upon climatic conditions (seasonal fluctuation). PSI recommends that the Contractor verify the actual groundwater and seepage conditions at the time of the construction activities and propose the groundwater control methods for the Engineer's approval, including the disposal of discharge water.

Every effort should be made to keep the excavations and any other prepared subgrades dry if water is encountered or if rainfall or snowmelt occurs during construction. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Water should not be allowed to collect in foundation or subsurface level excavations or other prepared subgrades of the construction area, either during or after construction. Water accumulation should be removed from shallow excavations by pumping from sump pits placed around the perimeter of the excavation. Positive site surface drainage should be provided to reduce infiltration of surface water. The grades should be sloped away from the proposed structures and surface drainage should be collected and discharged.

### **Excavation Safety Considerations**

Care must be taken so that all excavations are properly backfilled with suitable material compacted in accordance with the procedures outlined in this report. Before the backfill is placed, all water and loose debris should be removed from these excavations. Materials removed from the excavation should not be stockpiled immediately adjacent to the excavation, inasmuch as this load may cause a sudden collapse of the embankment. The Contractor should establish a minimum lateral distance from the crest of the slope for all vehicles and spoil piles. Likewise, the Contractor should establish protective measures for exposed slope faces and preventative measures for the buildup of moisture in the excavation sidewalls, which can cause slope instability. A slope stability analysis should be performed to determine the factor of safety for cut and fill depths if the depth of the excavations warrant. If temporary shoring of excavation sidewalls is performed, a qualified registered professional engineer must design it. Formed foundations will be required if placed on or within granular soils.





In Federal Register, Volume 54. No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, subpart P". This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations,

Whether they be utility trenches or footing excavations, be constructed in accordance with the current OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the Contractor could be liable for substantial penalties.

The Contractor is solely responsible for designing and constructing stable and safe, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The Contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

All earthwork and operations should be conducted in accordance with the project specifications and under the observation of a representative of the geotechnical engineer. We are providing this information solely as a service to Three Rivers Corporation. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations. Such responsibility is not being implied and should not be inferred.

### **GEOTECHNICAL RISK**

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitute PSI's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI's experience in working with these conditions.



## **REPORT LIMITATIONS**

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

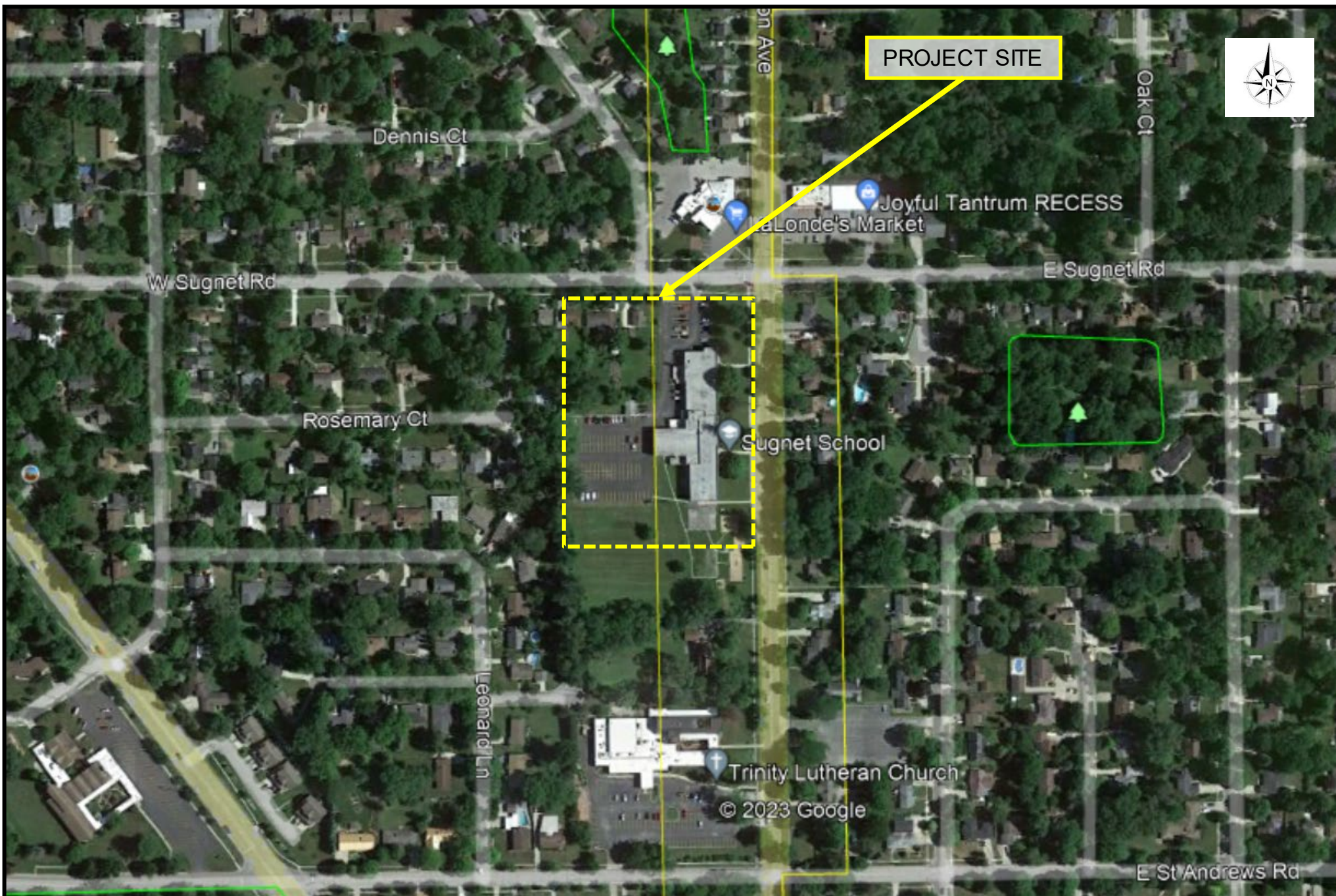
The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, PSI should be retained to review the final design plans and specifications. This review is required to verify that the engineering recommendations are appropriate for the final configuration, and that they have been properly incorporated into the design documents. This report has been prepared for the exclusive use of Three Rivers Corporation for specific application to the foundation of the proposed Midland County ESA Building Addition and Renovation will be located at 3917 Jefferson Avenue in the City of Midland, Midland County, Michigan.



## APPENDIX





SITE LOCATION DIAGRAM

Proposed Midland County ESA Building Addition and Renovation  
3917 Jefferson Avenue  
Midland, Michigan

FIGURE NO. 1

PSI Project No. 0406926  
Prepared By: T.K  
Prepared On: 2/20/2023





|   |   |  |       |     |                |     |   |                 |     |   |            |     |
|---|---|--|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/15/23<br><b>DATE COMPLETED:</b> 3/15/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 623 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-01</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width: 5%; text-align: center; font-weight: bold;">Water</td> <td style="width: 10%; text-align: center;">▽</td> <td style="width: 75%;">While Drilling</td> <td style="width: 10%; text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td style="text-align: center;">N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth   | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION   | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|-------------|-------------|------------|-------------------|--|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |             |             |            |                   |  |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 0                |               |             |             |            |                   | 4" TOPSOIL   |                     |                           |             |   |                    |
|                  |               |             |             | 1          | 16                | Dark brown SANDY CLAYwith Silt, trace Organics, trace Gravel, wet (FILL) |                     | 4-3-4<br>N=7              | 24          |   |                    |
| 620              |               |             |             | 2          | 16                | Light reddish brown SILTY CLAY, trace fine Sand, wet, firm to stiff      |                     | 6-9-4<br>N=13             | 20          |   |                    |
| 5                |               |             |             | 3          | 18                |  |                     | 5-5-8<br>N=13             | 26          |   |                    |
| 615              |               |             |             | 4          | 18                |  |                     | 3-6-7<br>N=13             | 26          |   |                    |
| 10               |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 610              |               |             |             | 5          | 16                |  | CL                  | 3-3-4<br>N=7              | 27          |   |                    |
| 15               |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 605              |               |             |             | 6          | 18                |  |                     | 2-2-3<br>N=5              | 30          |   |                    |
| 20               |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 600              |               |             |             | 7          | 18                |  |                     | 2-5-4<br>N=9              | 24          |   |                    |
| 25               |               |             |             |            |                   | Boring terminated approximately 25 feet below existing ground surface    |                     |                           |             |   |                    |

|  |  |  |
|--|--|--|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and Renovation<br><b>LOCATION:</b> 3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|--|

The stratification lines represent approximate boundaries. The transition may be gradual.

|   |   |   |       |     |                |     |   |                 |     |   |            |     |
|---|---|---|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/15/23<br><b>DATE COMPLETED:</b> 3/15/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 621 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-02</div> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width:5%; text-align: center; font-weight: bold;">Water</td> <td style="width:10%; text-align: center;">▽</td> <td style="width:75%;">While Drilling</td> <td style="width:10%; text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td style="text-align: center;">N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth  | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION  | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|-------------|-------------|------------|-------------------|---|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |             |             |            |                   |   |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 620              | 0             |             |             |            |                   | 5" TOPSOIL<br>Light reddish brown SILTY CLAY, trace fine Sand, wet, firm to stiff |                     |                           |             |   |                    |
|                  |               |             |             | 1          | 18                |   |                     | 2-1-1<br>N=2              | 28          |   |                    |
|                  |               |             |             | 2          | 18                |   |                     | 2-2-2<br>N=4              | 29          |   |                    |
| 615              | 5             |             |             | 3          | 18                |   |                     | 3-3-5<br>N=8              | 24          |   |                    |
|                  |               |             |             | 4          | 18                |   |                     | 4-7-7<br>N=14             | 27          |   |                    |
| 610              | 10            |             |             |            |                   |   | CL                  |                           |             |   |                    |
|                  |               |             |             | 5          | 18                |   |                     | 2-3-3<br>N=6              | 31          |   |                    |
| 605              | 15            |             |             |            |                   |   |                     |                           |             |   |                    |
|                  |               |             |             | 6          | 18                |   |                     | 3-5-5<br>N=10             | 30          |   |                    |
| 600              | 20            |             |             |            |                   |   |                     |                           |             |   |                    |
|                  |               |             |             | 7          | 18                |   |                     | 5-6-5<br>N=10             | 30          |   |                    |
|                  | 25            |             |             |            |                   | Boring terminated approximately 25 feet below existing ground surface             |                     |                           |             |   |                    |

|  |  |   |
|--|--|---|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and<br><b>LOCATION:</b> Renovation<br>3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|---|

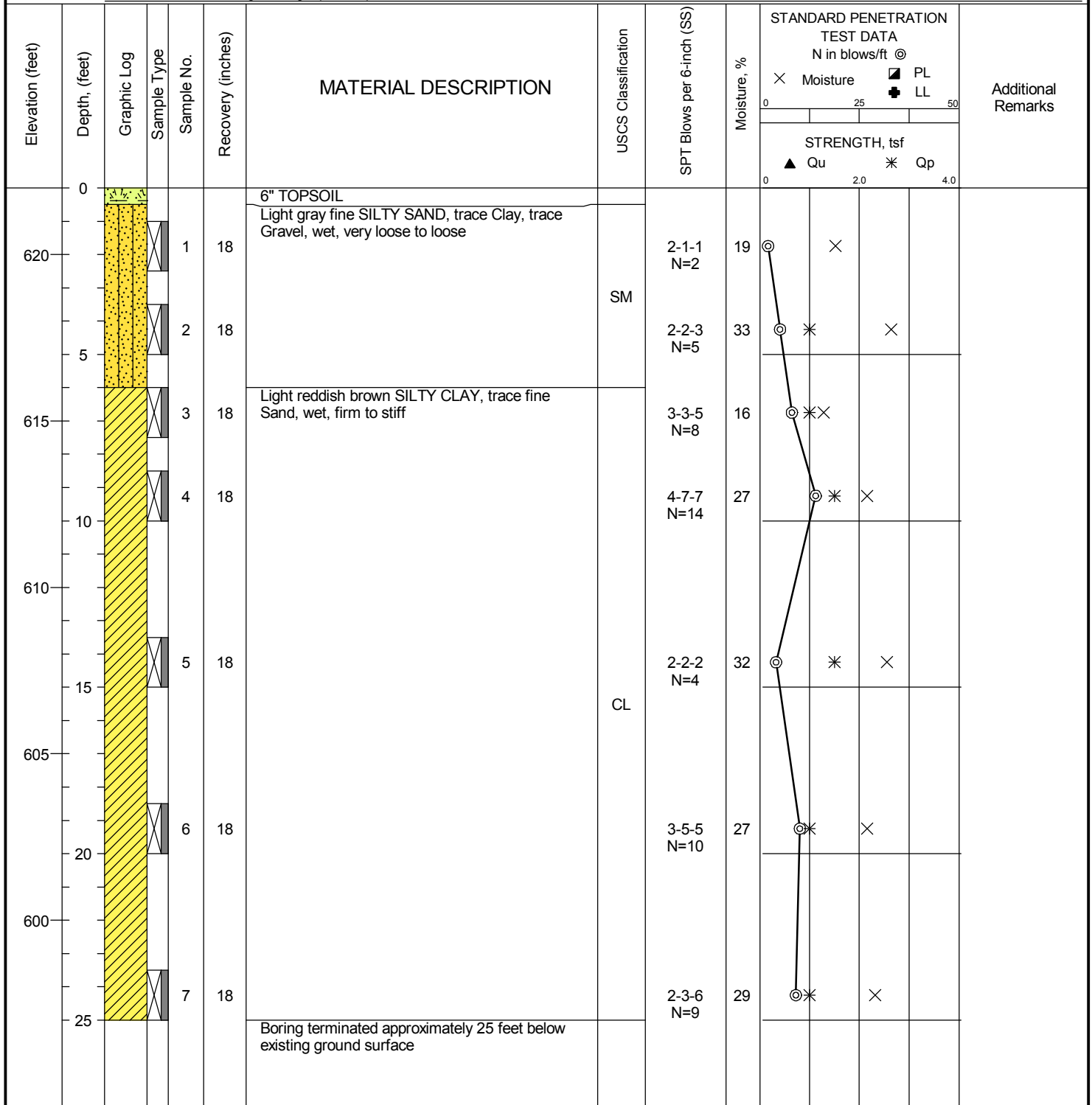
|   |   |   |       |     |                |     |   |                 |     |   |            |     |
|---|---|---|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/16/23<br><b>DATE COMPLETED:</b> 3/16/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 623 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-03</div> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width:5%; text-align: center; font-weight: bold;">Water</td> <td style="width:10%; text-align: center;">▽</td> <td style="width:75%;">While Drilling</td> <td style="width:10%; text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td style="text-align: center;">N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth  | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION  | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|-------------|-------------|------------|-------------------|---|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |             |             |            |                   |   |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 0                |               |             |             |            |                   | 5" TOPSOIL  |                     |                           |             |   |                    |
|                  |               |             |             | 1          | 16                | Yellowish brown fine to medium SAND with Silt, trace Gravel, wet, loose | SP-SM               | 3-2-3<br>N=5              | 21          |   |                    |
| 620              |               |             |             | 2          | 16                |   |                     | 3-3-5<br>N=8              | 25          |   |                    |
| 5                |               |             |             | 3          | 18                | Light reddish brown SILTY CLAY, trace fine Sand, wet, firm to stiff     |                     | 3-5-3<br>N=8              | 28          |   |                    |
| 615              |               |             |             | 4          | 18                |   |                     | 3-4-6<br>N=10             | 27          |   |                    |
|                  |               |             |             | 5          | 16                |   | CL                  | 2-4-4<br>N=8              | 31          |   |                    |
| 610              |               |             |             | 6          | 18                |   |                     | 3-4-4<br>N=8              | 26          |   |                    |
| 605              |               |             |             | 7          | 18                |   |                     | 3-4-4<br>N=8              | 29          |   |                    |
| 600              |               |             |             |            |                   | Boring terminated approximately 25 feet below existing ground surface   |                     |                           |             |   |                    |
| 25               |               |             |             |            |                   |   |                     |                           |             |   |                    |

|  |  |   |
|--|--|---|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and<br><b>LOCATION:</b> Renovation<br>3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|---|



|  |  |  |
|--|--|--|
| DATE STARTED: 3/15/23  | DRILL COMPANY: PSI                               | <b>BORING SB-04</b>  |
| DATE COMPLETED: 3/15/23  | DRILLER: D. Guajardo    LOGGED BY: I. Al-Hemyari |  |
| COMPLETION DEPTH: 25.0 ft  | DRILL RIG: CME-55                                | <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <b>Water</b><br/> <div style="display: flex; align-items: center;"> <div style="width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></div> While Drilling </div> <div style="display: flex; align-items: center;"> <div style="width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></div> Upon Completion </div> <div style="display: flex; align-items: center;"> <div style="width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></div> Cave Depth </div> </div> </div> |
| BENCHMARK: N/A   | DRILLING METHOD: 3 1/4" HSA                      |  |
| ELEVATION: 622 ft  | SAMPLING METHOD: SS                              |  |
| LATITUDE:  | HAMMER TYPE: Automatic                           | <b>BORING LOCATION:</b><br>See Boring Location Diagram   |
| LONGITUDE:   | EFFICIENCY: N/A                                  |  |
| STATION: N/A    OFFSET: N/A                                      | REVIEWED BY: T. Khalaff                          |  |
| REMARKS: Borehole backfilled with auger cuttings upon completion |  |  |



|  |                                       |   |
|--|---------------------------------------|---|
|  | Professional Service Industries, Inc. | PROJECT NO.: 0406-926                             |
|  | 3120 Sovereign Drive, Suite C         | PROJECT: Midland County ESA Building Addition and |
|  | Lansing, MI 48911                     | Renovation  |
|  | Telephone: (517) 394-5700             | 3917 Jefferson Avenue<br>Midland, Michigan        |

The stratification lines represent approximate boundaries. The transition may be gradual.

|   |   |  |       |     |                |     |   |                 |     |   |            |     |
|---|---|--|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/16/23<br><b>DATE COMPLETED:</b> 3/16/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 622 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-05</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width: 5%; text-align: center; font-weight: bold;">Water</td> <td style="width: 5%; text-align: center;">▽</td> <td style="width: 85%;">While Drilling</td> <td style="width: 5%;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td>N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td>N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth   | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION   | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|-------------|-------------|------------|-------------------|--|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |             |             |            |                   |  |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 0                |               |             |             |            |                   | 6" TOPSOIL   |                     |                           |             |   |                    |
| 620              |               |             |             | 1          | 18                | Light gray fine SILTY SAND, trace Clay, trace Gravel, wet, very loose to loose | SM                  | 3-2-2<br>N=4              | 24          |   |                    |
| 5                |               |             |             | 2          | 18                |  |                     | 4-3-4<br>N=7              | 31          |   |                    |
| 615              |               |             |             | 3          | 16                | Light reddish brown SILTY CLAY, trace fine Sand, wet, stiff                    |                     | 3-3-4<br>N=7              | 28          |   |                    |
| 10               |               |             |             | 4          | 18                |  |                     | 4-4-3<br>N=7              | 30          |   |                    |
| 610              |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 15               |               |             |             | 5          | 18                |  | CL                  | 3-3-4<br>N=7              | 28          |   |                    |
| 605              |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 20               |               |             |             | 6          | 18                |  |                     | 3-3-3<br>N=6              | 30          |   |                    |
| 600              |               |             |             |            |                   |  |                     |                           |             |   |                    |
| 25               |               |             |             | 7          | 18                |  |                     | 3-3-4<br>N=7              | 29          |   |                    |
|                  |               |             |             |            |                   | Boring terminated approximately 25 feet below existing ground surface          |                     |                           |             |   |                    |

|  |  |  |
|--|--|--|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and Renovation<br><b>LOCATION:</b> 3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|--|

The stratification lines represent approximate boundaries. The transition may be gradual.

|   |   |  |       |     |                |     |   |                 |     |   |            |     |
|---|---|--|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/16/23<br><b>DATE COMPLETED:</b> 3/16/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 621 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-06</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width: 5%; text-align: center; font-weight: bold;">Water</td> <td style="width: 10%; text-align: center;">▽</td> <td style="width: 85%;">While Drilling</td> <td style="width: 10%; text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td style="text-align: center;">N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth   | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log   | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION  | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|---|-------------|------------|-------------------|---|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |   |             |            |                   |   |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 620              | 0             | 8" TOPSOIL  |             |            |                   |   |                     |                           |             |   |                    |
|                  |               | Yellowish brown fine to medium SAND with Silt, trace Gravel, wet, loose |             | 1          | 18                |   | SP-SM               | 3-4-3<br>N=7              | 23          |   |                    |
|                  |               | Light reddish brown SILTY CLAY, trace fine Sand, wet, stiff             |             | 2          | 16                |   |                     | 6-5-5<br>N=10             | 29          |   |                    |
| 615              | 5             |   |             | 3          | 18                |   |                     | 5-5-5<br>N=10             | 31          |   |                    |
|                  |               |   |             | 4          | 18                |   |                     | 4-6-7<br>N=13             | 26          |   |                    |
| 610              | 10            |   |             |            |                   |   | CL                  | 4-4-5<br>N=9              | 26          |   |                    |
|                  |               |   |             | 5          | 18                |   |                     |                           |             |   |                    |
| 605              | 15            |   |             |            |                   |   |                     | 3-3-5<br>N=8              | 26          |   |                    |
|                  |               |   |             | 6          | 18                |   |                     |                           |             |   |                    |
| 600              | 20            |   |             |            |                   |   |                     | 3-4-4<br>N=8              | 25          |   |                    |
|                  |               |   |             | 7          | 18                |   |                     |                           |             |   |                    |
| 25               | 25            |   |             |            |                   | Boring terminated approximately 25 feet below existing ground surface |                     |                           |             |   |                    |

|  |  |   |
|--|--|---|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and<br><b>LOCATION:</b> Renovation<br>3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|---|

The stratification lines represent approximate boundaries. The transition may be gradual.

|   |   |  |       |     |                |     |   |                 |     |   |            |     |
|---|---|--|-------|-----|----------------|-----|---|-----------------|-----|---|------------|-----|
| <b>DATE STARTED:</b> 3/16/23<br><b>DATE COMPLETED:</b> 3/16/23<br><b>COMPLETION DEPTH:</b> 25.0 ft<br><b>BENCHMARK:</b> N/A<br><b>ELEVATION:</b> 620 ft<br><b>LATITUDE:</b><br><b>LONGITUDE:</b><br><b>STATION:</b> N/A <b>OFFSET:</b> N/A<br><b>REMARKS:</b> Borehole backfilled with auger cuttings upon completion | <b>DRILL COMPANY:</b> PSI<br><b>DRILLER:</b> D. Guajardo <b>LOGGED BY:</b> I. Al-Hemyari<br><b>DRILL RIG:</b> CME-55<br><b>DRILLING METHOD:</b> 3 1/4" HSA<br><b>SAMPLING METHOD:</b> SS<br><b>HAMMER TYPE:</b> Automatic<br><b>EFFICIENCY:</b> N/A<br><b>REVIEWED BY:</b> T. Khalaff | <div style="text-align: center; font-weight: bold; font-size: 1.2em;">BORING SB-07</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width: 5%; text-align: center; font-weight: bold;">Water</td> <td style="width: 10%; text-align: center;">▽</td> <td style="width: 85%;">While Drilling</td> <td style="width: 10%; text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▼</td> <td>Upon Completion</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td style="text-align: center;">▽</td> <td>Cave Depth</td> <td style="text-align: center;">N/A</td> </tr> </table> <b>BORING LOCATION:</b><br>See Boring Location Diagram | Water | ▽   | While Drilling | N/A | ▼ | Upon Completion | N/A | ▽ | Cave Depth | N/A |
| Water   | ▽   | While Drilling   |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▼   | Upon Completion  |       | N/A |                |     |   |                 |     |   |            |     |
|   | ▽   | Cave Depth   | N/A   |     |                |     |   |                 |     |   |            |     |

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION  | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA<br>N in blows/ft @       | Additional Remarks |
|------------------|---------------|-------------|-------------|------------|-------------------|---|---------------------|---------------------------|-------------|---|--------------------|
|                  |               |             |             |            |                   |   |                     |                           |             | X Moisture    PL<br>LL<br>STRENGTH, tsf<br>▲ Qu    * Qp |                    |
| 0                | 0             |             |             | 1          | 16                | 5" TOPSOIL<br>Dark brown SANDY CLAY with Silt, trace Organics, trace Gravel, wet (FILL) |                     | 2-3-2<br>N=5              | 33          | ⊙   |                    |
| 615              | 5             |             |             | 2          | 16                | Light reddish brown SILTY CLAY, trace fine Sand, wet, firm to stiff                     |                     | 2-3-3<br>N=6              | 28          | ⊙ *   |                    |
|                  |               |             |             | 3          | 18                |   |                     | 3-4-4<br>N=8              | 25          | ⊙ *   |                    |
| 610              | 10            |             |             | 4          | 16                |   |                     | 3-4-6<br>N=10             | 26          | ⊙ *   |                    |
| 605              | 15            |             |             | 5          | 18                |   | CL                  | 3-4-6<br>N=10             | 29          | ⊙ *   |                    |
| 600              | 20            |             |             | 6          | 18                |   |                     | 2-2-3<br>N=5              | 29          | ⊙ *   |                    |
| 595              | 25            |             |             | 7          | 18                |   |                     | 3-3-4<br>N=7              | 27          | ⊙ *   |                    |
|                  |               |             |             |            |                   | Boring terminated approximately 25 feet below existing ground surface                   |                     |                           |             |   |                    |

|  |  |  |
|--|--|--|
|  | Professional Service Industries, Inc.<br>3120 Sovereign Drive, Suite C<br>Lansing, MI 48911<br>Telephone: (517) 394-5700 | <b>PROJECT NO.:</b> 0406-926<br><b>PROJECT:</b> Midland County ESA Building Addition and Renovation<br><b>LOCATION:</b> 3917 Jefferson Avenue<br>Midland, Michigan |
|--|--|--|

The stratification lines represent approximate boundaries. The transition may be gradual.

## GENERAL NOTES

### SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

### DRILLING AND SAMPLING SYMBOLS

|  |   |
|--|---|
| SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.           | ☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted. |
| HSA: Hollow Stem Auger - typically 3 1/4" or 4 1/4" I.D. openings, except where noted. | ■ ST: Shelby Tube - 3" O.D., except where noted.              |
| M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry                 | ▮ RC: Rock Core   |
| R.C.: Diamond Bit Core Sampler   | ↓ TC: Texas Cone  |
| H.A.: Hand Auger   | ☞ BS: Bulk Sample   |
| P.A.: Power Auger - Handheld motorized auger   | ☒ PM: Pressuremeter   |
|  | CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings  |

### SOIL PROPERTY SYMBOLS

|   |
|---|
| N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon. |
| N <sub>60</sub> : A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)  |
| Q <sub>u</sub> : Unconfined compressive strength, TSF   |
| Q <sub>p</sub> : Pocket penetrometer value, unconfined compressive strength, TSF                                  |
| w%: Moisture/water content, %   |
| LL: Liquid Limit, %   |
| PL: Plastic Limit, %  |
| PI: Plasticity Index = (LL-PL), %   |
| DD: Dry unit weight, pcf  |
| ▼, ▽, ▾ Apparent groundwater level at time noted  |

### RELATIVE DENSITY OF COARSE-GRAINED SOILS

| Relative Density | N - Blows/foot |
|------------------|----------------|
| Very Loose       | 0 - 4          |
| Loose            | 4 - 10         |
| Medium Dense     | 10 - 30        |
| Dense            | 30 - 50        |
| Very Dense       | 50 - 80        |
| Extremely Dense  | 80+            |

### ANGULARITY OF COARSE-GRAINED PARTICLES

| Description | Criteria   |
|-------------|--|
| Angular:    | Particles have sharp edges and relatively plane sides with unpolished surfaces |
| Subangular: | Particles are similar to angular description, but have rounded edges           |
| Subrounded: | Particles have nearly plane sides, but have well-rounded corners and edges     |
| Rounded:    | Particles have smoothly curved sides and no edges                              |

### GRAIN-SIZE TERMINOLOGY

| Component              | Size Range                             |
|------------------------|--|
| Boulders:              | Over 300 mm (>12 in.)                  |
| Cobbles:               | 75 mm to 300 mm (3 in. to 12 in.)      |
| Coarse-Grained Gravel: | 19 mm to 75 mm (3/4 in. to 3 in.)      |
| Fine-Grained Gravel:   | 4.75 mm to 19 mm (No.4 to 3/4 in.)     |
| Coarse-Grained Sand:   | 2 mm to 4.75 mm (No.10 to No.4)        |
| Medium-Grained Sand:   | 0.42 mm to 2 mm (No.40 to No.10)       |
| Fine-Grained Sand:     | 0.075 mm to 0.42 mm (No. 200 to No.40) |
| Silt:                  | 0.005 mm to 0.075 mm                   |
| Clay:                  | <0.005 mm                              |

### PARTICLE SHAPE

| Description       | Criteria  |
|-------------------|---|
| Flat:             | Particles with width/thickness ratio > 3            |
| Elongated:        | Particles with length/width ratio > 3               |
| Flat & Elongated: | Particles meet criteria for both flat and elongated |

### RELATIVE PROPORTIONS OF FINES

| Descriptive Term | % Dry Weight |
|------------------|--------------|
| Trace:           | < 5%         |
| With:            | 5% to 12%    |
| Modifier:        | >12%         |

## GENERAL NOTES

(Continued)

### CONSISTENCY OF FINE-GRAINED SOILS

| <u>Q<sub>u</sub> - TSF</u> | <u>N - Blows/foot</u> | <u>Consistency</u>  |
|----------------------------|-----------------------|---------------------|
| 0 - 0.25                   | 0 - 2                 | Very Soft           |
| 0.25 - 0.50                | 2 - 4                 | Soft                |
| 0.50 - 1.00                | 4 - 8                 | Firm (Medium Stiff) |
| 1.00 - 2.00                | 8 - 15                | Stiff               |
| 2.00 - 4.00                | 15 - 30               | Very Stiff          |
| 4.00 - 8.00                | 30 - 50               | Hard                |
| 8.00+                      | 50+                   | Very Hard           |

### MOISTURE CONDITION DESCRIPTION

| <u>Description</u> | <u>Criteria</u>                                       |
|--------------------|---|
| Dry:               | Absence of moisture, dusty, dry to the touch          |
| Moist:             | Damp but no visible water                             |
| Wet:               | Visible free water, usually soil is below water table |

### RELATIVE PROPORTIONS OF SAND AND GRAVEL

| <u>Descriptive Term</u> | <u>% Dry Weight</u> |
|-------------------------|---------------------|
| Trace:                  | < 15%               |
| With:                   | 15% to 30%          |
| Modifier:               | >30%                |

### STRUCTURE DESCRIPTION

| <u>Description</u> | <u>Criteria</u>   | <u>Description</u> | <u>Criteria</u>   |
|--------------------|---|--------------------|---|
| Stratified:        | Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick  | Blocky:            | Cohesive soil that can be broken down into small angular lumps which resist further breakdown |
| Laminated:         | Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick | Lensed:            | Inclusion of small pockets of different soils   |
| Fissured:          | Breaks along definite planes of fracture with little resistance to fracturing             | Layer:             | Inclusion greater than 3 inches thick (75 mm)   |
| Slickensided:      | Fracture planes appear polished or glossy, sometimes striated                             | Seam:              | Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample                |
|                    |   | Parting:           | Inclusion less than 1/8-inch (3 mm) thick   |

### SCALE OF RELATIVE ROCK HARDNESS

| <u>Q<sub>u</sub> - TSF</u> | <u>Consistency</u> |
|----------------------------|--------------------|
| 2.5 - 10                   | Extremely Soft     |
| 10 - 50                    | Very Soft          |
| 50 - 250                   | Soft               |
| 250 - 525                  | Medium Hard        |
| 525 - 1,050                | Moderately Hard    |
| 1,050 - 2,600              | Hard               |
| >2,600                     | Very Hard          |

### ROCK BEDDING THICKNESSES

| <u>Description</u> | <u>Criteria</u>                       |
|--------------------|---------------------------------------|
| Very Thick Bedded  | Greater than 3-foot (>1.0 m)          |
| Thick Bedded       | 1-foot to 3-foot (0.3 m to 1.0 m)     |
| Medium Bedded      | 4-inch to 1-foot (0.1 m to 0.3 m)     |
| Thin Bedded        | 1¼-inch to 4-inch (30 mm to 100 mm)   |
| Very Thin Bedded   | ½-inch to 1¼-inch (10 mm to 30 mm)    |
| Thickly Laminated  | 1/8-inch to ½-inch (3 mm to 10 mm)    |
| Thinly Laminated   | 1/8-inch or less "paper thin" (<3 mm) |

### ROCK VOIDS

| <u>Voids</u> | <u>Void Diameter</u>            |
|--------------|---------------------------------|
| Pit          | <6 mm (<0.25 in)                |
| Vug          | 6 mm to 50 mm (0.25 in to 2 in) |
| Cavity       | 50 mm to 600 mm (2 in to 24 in) |
| Cave         | >600 mm (>24 in)                |

### GRAIN-SIZED TERMINOLOGY

| <u>(Typically Sedimentary Rock)</u> |                    |
|-------------------------------------|--------------------|
| <u>Component</u>                    | <u>Size Range</u>  |
| Very Coarse Grained                 | >4.76 mm           |
| Coarse Grained                      | 2.0 mm - 4.76 mm   |
| Medium Grained                      | 0.42 mm - 2.0 mm   |
| Fine Grained                        | 0.075 mm - 0.42 mm |
| Very Fine Grained                   | <0.075 mm          |

### ROCK QUALITY DESCRIPTION



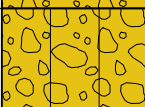
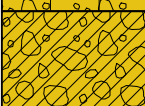
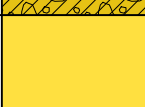

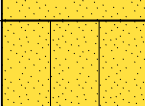


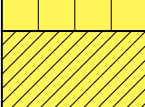
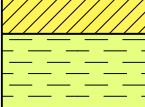



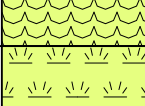
| <u>Rock Mass Description</u> | <u>RQD Value</u> |
|------------------------------|------------------|
| Excellent                    | 90 - 100         |
| Good                         | 75 - 90          |
| Fair                         | 50 - 75          |
| Poor                         | 25 - 50          |
| Very Poor                    | Less than 25     |

### DEGREE OF WEATHERING

|                     |   |
|---------------------|---|
| Slightly Weathered: | Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.                          |
| Weathered:          | Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.                |
| Highly Weathered:   | Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife. |

# SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

| MAJOR DIVISIONS   |   |   | SYMBOLS   |        | TYPICAL DESCRIPTIONS   |
|---|---|---|---|--------|--|
|   |   |   | GRAPH   | LETTER |  |
| COARSE GRAINED SOILS<br><br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br><br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br><br>(LITTLE OR NO FINES)               |    | GW     | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES  |
|   |   |   |    | GP     | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES  |
|   |   | GRAVELS WITH FINES<br><br>(APPRECIABLE AMOUNT OF FINES) |    | GM     | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES   |
|   |   |   |    | GC     | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES  |
|   | SAND AND SANDY SOILS<br><br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE       | CLEAN SANDS<br><br>(LITTLE OR NO FINES)                 |    | SW     | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES  |
|   |   |   |    | SP     | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES   |
|   |   | SANDS WITH FINES<br><br>(APPRECIABLE AMOUNT OF FINES)   |    | SM     | SILTY SANDS, SAND - SILT MIXTURES  |
|   |   |   |   | SC     | CLAYEY SANDS, SAND - CLAY MIXTURES   |
| FINE GRAINED SOILS<br><br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE  | SILTS AND CLAYS<br><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><br>LIQUID LIMIT GREATER THAN 50                                       |   |  | MH     | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS  |
|   |   |   |  | CH     | INORGANIC CLAYS OF HIGH PLASTICITY   |
|   |   |   |  | OH     | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS  |
| HIGHLY ORGANIC SOILS  |   |   |  | PT     | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS  |

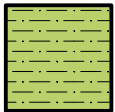
# Graphic Symbols for Materials and Rock Deposits



**CONCRETE**  
Portland Cement Concrete



**BITUMINOUS CONCRETE**



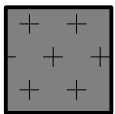
**CLAYSTONE**



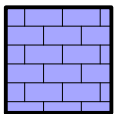
**COAL**  
Coal, Anthracite Coal



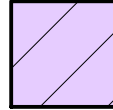
**CONGLOMERATE/BRECCIA**  
Conglomerate, Breccia



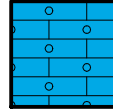
**IGNEOUS ROCK**  
Anorthosite, Basalt, Metabasalt, Diabase (Gabbro), Gabbro, Granite/Granodiorite, Hornfels, Pegmatite, Rhyolite/Metarhyolite



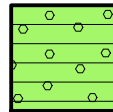
**LIMESTONE**  
Limestone, Dolomite



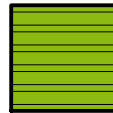
**METAMORPHIC ROCK**  
Amphibolite, Gneiss, Marble, Phyllite, Quartzite, Schist, Serpentine, Slate



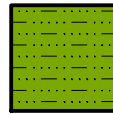
**CHERT**



**SANDSTONE**  
Sandstone, Orthoquartzite (Sandstone)



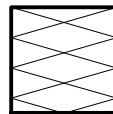
**SHALE**



**SILTSTONE**



**NO RECOVERY**



**VOID**



# Important Information About Your Geotechnical Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*The following information is provided to help you manage your risks.*

## **Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects**

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

## **Read the Full Report**

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## **A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors**

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## **Subsurface Conditions Can Change**

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## **Most Geotechnical Findings Are Professional Opinions**

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## **A Report's Recommendations Are *Not* Final**

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual



subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## **A Geotechnical Engineering Report Is Subject to Misinterpretation**

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## **Do Not Redraw the Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## **Give Contractors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study.* Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## **Read Responsibility Provisions Closely**

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## **Geoenvironmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## **Rely, on Your ASFE-Member Geotechnical Engineer for Additional Assistance**

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



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## **Intertek**

For more than 135 years, companies around the world have depended on Intertek to help ensure the quality and safety of their products, processes and systems.

We go beyond testing, inspecting and certifying products; we are a Total Quality Assurance provider to industries worldwide. Through our global network of state-of-the-art facilities and industry-leading technical expertise we provide innovative and bespoke Assurance, Testing, Inspection and Certification services to customers. We provide a systemic approach to supporting our customers' Quality Assurance efforts in each of the areas of their operations including R&D, raw materials sourcing, components suppliers, manufacturing, transportation, distribution and retail channels, and consumer management.

Intertek is an industry leader with more than 42,000 employees in 1,000 locations in over 100 countries. We deliver Quality Assurance expertise 24 hours a day, 7 days a week with our industry-winning processes and customer-centric culture. Whether your business is local or global, we can help to ensure that your products meet quality, health, environmental, safety, and social accountability standards for virtually any market around the world. We hold extensive global accreditations, recognitions, and agreements, and our knowledge of and expertise in overcoming regulatory, market, and supply chain hurdles is unrivaled.

***Our Mission***  
**To exceed our customers' expectations with innovative and bespoke Assurance, Testing, Inspection and Certification services for their operations and supply chain. Globally. 24/7.**

Intertek can sharpen your competitive edge

- With reliable testing and certification for faster regulatory approval
- Through rapid, efficient entry to virtually any market in the world
- With Total Quality Assurance across your supply chain
- Through innovative leadership in meeting social accountability standards
- By reducing cost and minimizing health, safety, and security risks
- By becoming a TRUSTED BRAND



## **PSI**

Professional Service Industries, Inc. (PSI), an Intertek company, nationally recognized consulting engineering and testing firm providing integrated services in several disciplines, including environmental consulting, building envelope consulting and testing, geotechnical engineering, construction materials testing and engineering, asbestos management and facilities engineering and consulting. We are recognized as one of the largest engineering design consulting companies in the US. We have been providing engineering consulting services to Fortune 500 clients and governmental agencies for over 100 years. However, our proudest accomplishment is the large number of clients that we have serviced for many years that keep coming back because of our responsiveness, commitment to listening to our clients, and consistent quality of service.

PSI has been providing business and industry with objective, accurate and useful information for more than 100 years. Today, we employ approximately 2,300 skilled personnel in 100 offices nationwide.

Distinguished as both a local and a national leader in engineering and environmental services, PSI is recognized in several disciplines including the following:

- Geotechnical Engineering
- Construction Materials Testing and Special Inspection
- Environmental Consulting
- Industrial Hygiene
- Nondestructive Examination
- Pavement Evaluation Services
- Building Science Solutions
  - Building Envelope
  - Curtainwall
  - Acoustic
  - Fire/Life Safety
  - Technology
  - Roof Consulting

**PSI can provide outstanding consulting engineering and testing services; however, most of all we desire to demonstrate our commitment to excellence.**

PSI provides its clients with ***Information To Build On*** in making knowledgeable, cost-effective business decisions that help their clients reduce expenses, improve quality and decrease liabilities.

## **A Commitment To Excellence**

PSI maintains the highest professional and ethical standards, which include an economic awareness to provide the highest quality of personnel and service at a reasonable cost to our clients. Our unique combination of local, independent offices and nationwide resources means our project managers have the full responsibility for managing your local projects, and also have the national resources to handle the most challenging and complex projects, regardless of size.

While PSI's growth has been notable, even more impressive has been our ability to grow without sacrificing our technical knowledge or personalized attention to our clients. Recognition of the importance of our clients and repeat business has been a key factor in PSI's success. PSI will not sacrifice quality, value, or service to our clients.

## A Commitment To Excellence (continued)

Our staff of professionals consists of the following:

- Professional Engineers (PE/PEng)
- Registered Roof Consultants (RRC)
- Registered Architects (AIA)
- Certified Industrial Hygienists (CIH)
- Registered Soil Scientists
- Engineers-In-Training (EIT)
- Registered Geologists

Our field and laboratory technicians are trained in-house and at special schools and seminars. Our project managers and technicians are certified by associations such as the following and also work with other specialized organizations within each discipline.

- Roofing Industry Educational Institute (RIEI)
- Roof Consultants Institute (RCI)
- American Concrete Institute (ACI)
- National Institute for the Certification of Engineering Technicians (NICET)
- American Welding Society (AWS)
- International Code Council (ICC)
- International Fire Council (IFC)

Since our founding, we have dedicated ourselves to excellence both in our technical expertise and in customer service. It is this principal upon which we have based our organization and established a national reputation as a leader in the field of professional engineering, testing and consulting services.

**PSI's Vision... is to be the most trusted, integrated provider of "Information To Build On" for clients that buy, sell, design, construct, develop, finance and manage properties and infrastructure. By being safe 24/7/365, hiring and retaining the best employees, efficiently managing projects, and building close client relationships, we will be successful in growing PSI and in balancing the needs of our employees, clients and investors.**

SECTION 005000 - AVAILABILITY OF ELECTRONIC FILES

PART 1 - GENERAL

1.1 POLICY

- A. As a service to bidders, contractors, subcontractors, vendors, material suppliers and others needing electronic copies of drawing files, the Architect will provide electronic files via file transfer through the Project Website in accordance with the following policy.
1. In accepting and utilizing any drawings or data generated and furnished by WTA Architects, the Receiver agrees that all such electronic files are instruments of service of WTA Architects and its consultants, who shall be deemed the author, and shall retain all common law, statutory law and other rights, without limitation, including copyrights.
  2. The Receiver agrees not to reuse these electronic files, in whole or in part, for any purpose other than for the Project. The Receiver agrees not to transfer these electronic files to others without the prior written consent of WTA Architects or its consultants. The Receiver further agrees that WTA Architects and its consultants shall have no responsibility or liability to Receiver or others for any changes made it shall be the Receiver's responsibility to be aware of changes made by WTA Architects, its consultants or the Owner.
  3. It is further understood and agreed that the undersigned Receiver will hold WTA Architects and its consultants harmless, indemnify and defend WTA Architects and its consultants from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
  4. It is understood and agreed that the items transmitted are prepared from electronic files current at the time of preparation. **All files are AutoCAD 2018.** The Receiver will specify on request form if an older version is required.
  5. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
  6. As a record of information to be transmitted, WTA Architects will prepare a duplicate back-up for its files, which may be electronic or hard-copy.
  7. Compensation for providing this material will be as follows:
    - a. Base Fee of \$250 for 1 to 3 drawings.
    - b. Base Fee of \$500 for 4 to 10 drawings.
    - c. For each additional drawing after 10 the fee is \$40.00 per drawing (i.e. 11 drawings = \$540)
  8. Payment must be provided along with a signed copy of the Release Letter before files will be released.

1.2 REQUEST PROCEDURE

- B. To receive files the attached Release Letter must be completed in full and submitted to the Project Manager at WTA Architects.
1. A signed copy of the Release Letter must be submitted; faxed or emailed copies will be accepted. However, files will not be exchanged until payment has been received.
  2. Upon remittance of the signed Release Letter and Fee, allow five working days for processing.

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

**Firm Requesting Files:**

Date: \_\_\_\_\_

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_  
City, State, Zip: \_\_\_\_\_

Phone: \_\_\_\_\_

**Re: Letter of Authorization for Electronic File Transfers**

Project Name: \_\_\_\_\_

WTA Project No.: \_\_\_\_\_

Dear Sir:

Per your request, WTA Architects will transmit the requested electronic files via file transfer through the project website upon receipt of this letter with conditions of agreement as stated.

1. In accepting and utilizing any drawings or data generated and furnished by WTA Architects, the Receiver agrees that all such electronic files are instruments of service of WTA Architects and its consultants, who shall be deemed the author, and shall retain all common law, statutory law and other rights, without limitation, including copyrights.
2. The Receiver agrees not to reuse these electronic files, in whole or in part, for any purpose other than for the Project. The Receiver agrees not to transfer these electronic files to others without the prior written consent of WTA Architects or its consultants. The Receiver further agrees that WTA Architects and its consultants shall have no responsibility or liability to the Receiver or others for any changes made it shall be the Contractors responsibility to be aware of changes made by WTA Architects, its consultants or the Owner.
3. It is further understood and agreed that the undersigned will hold WTA Architects and its consultants harmless, indemnify and defend WTA Architects and its consultants from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
4. It is understood and agreed that the items transmitted are prepared from electronic files current at the time of preparation. **All files are AutoCAD 2018**, unless requested otherwise.
5. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
6. As a record of information to be transmitted, we will prepare a duplicate back-up for our files, which may be electronic or hard-copy.
7. Compensation for providing this material will be as follows: Base Fee of \$250 for 1 to 3 drawings and a Base Fee of \$500 for 4 to 10 drawings; for each additional drawing after 10 the fee is \$40.00 per drawing (i.e. 11 drawings = \$540). Payment must be provided along with a signed copy of this form before files will be released. Please remit to WTA Architects and allow five working days for processing.

Fee: \$ \_\_\_\_\_ Drawings: \_\_\_\_\_

Signed: \_\_\_\_\_ Printed Name/Title: \_\_\_\_\_

*To be Completed by WTA Architects, Inc.*

Released (Signed By): \_\_\_\_\_ WTA Architects, Inc.

Printed Name/Title: \_\_\_\_\_ Date: \_\_\_\_\_

END OF SECTION 005000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

- A. Project Identification: Handley Elementary School, Architect Project No. 2022006.1.
  - 1. Project Location: 3917 Jefferson Avenue, Midland, Michigan, 48640.
- B. Owner: Midland County ESA, 3917 Jefferson Avenue, Midland, Michigan, 48640.
  - 1. Owner's Representative: John Searles, Superintendent, [suptsearles@midlandesa.org](mailto:suptsearles@midlandesa.org).
- C. Architect: WTA Architects, 100 S. Jefferson Ave, Ste 601, Saginaw, Michigan, 48607.
  - 1. Contact: Paul Haselhuhn, Project Architect, (989) 752-8107, [phaselhuhn@wtaarch.com](mailto:phaselhuhn@wtaarch.com).
- D. Construction Manager: Three Rivers Construction, Inc., 3069 Vantage Point Drive, Midland, Michigan, 48640.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. Renovation of existing school building of approximately 50,000 square feet and Addition of a 13,000 square foot classroom and entry including sitework, utilities, and other Work indicated in the Contract Documents.

1.4 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. 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.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Replace one (1) square foot of brick, single wythe, based on seven (7) brick units per square foot.
- B. Unit Price No. 2: Replace one (1) lineal foot of masonry mortar.
- C. Unit Price No. 3: Install one (1) helical brick tie and patch mortar at tie.
- D. Unit Price No. 4: Replace one (1) lineal foot of steel lintel.
- E. Unit Price No. 5: Install one (1) square foot of 5.2 inch rigid roof insulation.
- F. Unit Price No. 6: Removal and replacement of damaged 2" thick gypsum roof deck on form board with reinforcement to match existing roof deck reinforcement and profile.
- G. Unit Price No. 7: Remove existing stone cap and install stainless steel through-wall flashing and reinstall stone cap.

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END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 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 the 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.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. 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.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. 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

- A. Alternate No. 1: Fleet Parking Canopy.
  - 1. Base Bid: Provide Canopy as detailed in Contract Documents.
  - 2. Alternate: Provide Pre-Engineered Canopy.

END OF SECTION 012300

## SECTION 01 2500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 2500.01 - WTA Substitution Request Form.

#### 1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
- B. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
- C. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
  - 1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. Forms included in the Project Manual are adequate for this purpose, and must be used.

- D. Limit each request to a single proposed substitution item.
  - 1. Submit an electronic document, combining the request form with supporting data into a single document.

### 3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Substitution Request Form: WTA Substitution Request Form must be completed and provided at the beginning of each substitution request.
  - 1. Refer to Section 01 2500.01 - WTA Substitution Request Form.
  - 2. Submittals without a completed WTA Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- B. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period.

### 3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Substitution Request Form: WTA Substitution Request Form must be completed and provided at the beginning of each substitution request.
  - 1. Refer to Section 01 2500.01 - WTA Substitution Request Form.
  - 2. Submittals without a completed WTA Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
  - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
  - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  - 3. Bear the costs engendered by proposed substitution of:
    - Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
    - Other unanticipated project considerations.
- D. Substitutions will not be considered under one or more of the following circumstances:
  - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

2. Without a separate written request.

#### 3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
  1. During construction, Architect's decision following review of proposed substitution will be noted on the submitted form.
  2. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.

#### 3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

#### 3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION - 012500

Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.

- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.

Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.

Bear the costs engendered by proposed substitution of:

Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

Other unanticipated project considerations.

- D. Substitutions will not be considered under one or more of the following circumstances:

When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

Without a separate written request.

### **3.07 RESOLUTION**

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.

During construction, Architect's decision following review of proposed substitution will be noted on the submitted form.

During bidding, Architect will approve substitution requests by issuing an Addendum.

Substitutions not approved by addendum are rejected.

### **3.08 ACCEPTANCE**

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

### **3.09 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION

NEW ADDITION AND RENOVATION FOR:  
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MIDLAND, MICHIGAN

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**SECTION 01 2500.01 - WTA SUBSTITUTION REQUEST FORM**

SUBSTITUTION REQUEST NUMBER: \_\_\_\_\_ DATE SUBMITTED: \_\_\_\_\_  
WTA PROJECT NUMBER \_\_\_\_\_ PROJECT NAME: \_\_\_\_\_

**SPECIFIED ITEM**

SPECIFICATION TITLE: \_\_\_\_\_  
SPECIFICATION SECTION \_\_\_\_\_ SPECIFICATION ARTICLE/PARAGRAPH: \_\_\_\_\_  
SPECIFIED PRODUCT / DESCRIPTION: \_\_\_\_\_  
SPECIFIED MANUFACTURER: \_\_\_\_\_  
SPECIFIED PRODUCT / MODEL: \_\_\_\_\_  
REASON SPECIFIED ITEM CANNOT BE PROVIDED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PROPOSED SUBSTITUTION**

DESCRIPTION OF PROPOSED SUBSTITUTION: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
PROPOSED MANUFACTURER: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
WEBSITE: \_\_\_\_\_  
PRODUCT / MODEL: \_\_\_\_\_  
YEARS PRODUCT/MODEL HAS BEEN MANUFACTURED: \_\_\_\_\_  
DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

WILL PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK? ☐ NO ☐ YES

IF YES, EXPLAIN HOW: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

HOW WILL SUBSTITUTION BENEFIT THE OWNER: ☐ COST SAVINGS ☐ TIME SAVINGS ☐  
OTHER



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PROVIDE SPECIFIC DETAILS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THE FOLLOWING INFORMATION IS REQUIRED; CHECK TO INDICATE  
INFORMATION IS ATTACHED. (REQUEST WILL BE REJECTED WITHOUT  
REQUIRED DATA)

32.01

- A. ☐ List of references where proposed product has been installed; include address, owner, architect, and date installed.
- B. ☐ Product data sheets.
- C. ☐ Applicable certificates and test reports.
- D. ☐ Comparative Data: Provide point-by-point, side-by-side comparison of specified product and proposed substitution addressing essential attributes specified.

INDICATE WHICH OF THE FOLLOWING VOLUNTARY INFORMATION IS ATTACHED, IF ANY:

- ☐ **DRAWINGS.**
- ☐ **SAMPLES.**
- ☐ **OTHER ITEMS:** \_\_\_\_\_

**SIGNATURE**

THE UNDERSIGNED CERTIFIES:

1. The proposed substitution meets or exceeds the quality level of the specified product, equipment, assembly, or system.
2. To provide the same warranty for the substitution as for the specified product.
3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
5. The proposed substitution will have no adverse effects on other work. The proposed substitution will not affect project schedule.
6. Waives claims for additional costs or time extension that may subsequently become apparent.

CONTRACTOR / COMPANY: \_\_\_\_\_

SIGNED BY: \_\_\_\_\_ PRINTED NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

EMAIL: \_\_\_\_\_ PHONE: \_\_\_\_\_

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### ARCHITECT'S RESPONSE

- A. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.
- B. During construction, Architect will notify Contractor in writing (see below) of decision to accept or reject request, and incorporate the substitution into the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments as provided for in the Conditions of the Contract.

☐ SUBSTITUTION APPROVED - PROVIDE SUBMITTALS PER SECTION 01 3000 AND RESPECTIVE SECTION FOR WHICH SUBSTITUTION WAS MADE.

☐ SUBSTITUTION REJECTED - PROVIDE SPECIFIED MATERIALS.

SIGNED BY: \_\_\_\_\_ PRINTED NAME: \_\_\_\_\_

ARCHITECT'S COMMENTS: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

END OF SECTION - 012500.01

## SECTION 01 4000 QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- C. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
- D. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
- D. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- E. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- F. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.
- G. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- H. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- I. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- J. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- K. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- L. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED-DESIGN SERVICES

- A. 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.

### 1.4 CONFLICTING REQUIREMENTS

- B. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.

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

#### 1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
- B. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

#### 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
  2. Statement that products at Project site comply with requirements.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
  2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  3. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
- G. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- I. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- K. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:  
  
Provide test specimens representative of proposed products and construction.  
  
Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.  
  
Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.  
  
When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- L. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
  7. Allow seven days for initial review and each re-review of each mockup.
  8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  9. Retain subparagraph below as the default requirement and add specific requirements in individual Specification Sections.



10. Demolish and remove mockups when directed unless otherwise indicated.

#### 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
- B. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
- C. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- D. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  1. Engage a qualified testing agency to perform quality-control services.
  2. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- G. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."
- H. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- I. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. Security and protection for samples and for testing and inspection equipment at Project site.
- J. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency/special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections on the drawings and the schedule of Special Inspections attached to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

| SCHEDULE OF SPECIAL INSPECTION SERVICES   |  |                            |                |        |                |
|---|--|----------------------------|----------------|--------|----------------|
| PROJECT   |  |                            |                |        |                |
| MATERIAL / ACTIVITY   | SERVICE  | APPLICABLE TO THIS PROJECT |                |        |                |
|   |  | Y/N                        | EXTENT         | AGENT* | DATE COMPLETED |
| <b>1704.2.5 Inspection of Fabricators</b>   |  |                            |                |        |                |
| Verify fabrication/quality control procedures   | In-plant review (3)                                | Y                          | Periodic       |        |                |
| <b>1705.1.1 Special Cases</b> (work unusual in nature, including but not limited to alternative materials and systems, unusual design applications, materials and systems with special manufacturer's requirements) | Submittal review, shop (3) and/or field inspection | N                          |                |        |                |
| <b>1705.2 Steel Construction</b>  |  |                            |                |        |                |
| 1. Fabricator and erector documents (Verify reports and certificates as listed in AISC 360, chapter N, paragraph 3.2 for compliance with construction documents)  | Submittal Review                                   | Y                          | Each submittal |        |                |
| 2. Material verification of structural steel  | Shop (3) and field inspection                      | Y                          | Periodic       |        |                |
| 3. Embedments (Verify diameter, grade, type, length, embedment. See 1705.3 for anchors)   | Field inspection                                   | Y                          | Periodic       |        |                |

|   |   |   |                                 |  |  |
|---|---|---|---------------------------------|--|--|
| 4. Verify member locations, braces, stiffeners, and application of joint details at each connection comply with construction documents                    | Field inspection  | Y | Periodic                        |  |  |
| 5. Structural steel welding:  |   |   |                                 |  |  |
| a. Inspection tasks Prior to Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-1)                 | Shop (3) and field inspection                               | Y | Observe or Perform as noted (4) |  |  |
| b. Inspection tasks During Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-2)                   | Shop (3) and field inspection                               | Y | Observe (4)                     |  |  |
| c. Inspection tasks After Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-3)                    | Shop (3) and field inspection                               | Y | Observe or Perform as noted (4) |  |  |
| d. Nondestructive testing (NDT) of welded joints: <i>see Commentary</i>   |   |   |                                 |  |  |
| 1) Complete penetration groove welds 5/16" or greater in <i>risk category</i> III or IV   | Shop (3) or field ultrasonic testing - 100%                 | N | Periodic                        |  |  |
| 2) Complete penetration groove welds 5/16" or greater in <i>risk category</i> II  | Shop (3) or field ultrasonic testing - 10% of welds minimum | Y | Periodic                        |  |  |
| 3) Thermally cut surfaces of access holes when material $t > 2"$  | Shop (3) or field magnetic Partical or Penetrant testing    | N | Periodic                        |  |  |
| 4) Welded joints subject to fatigue when required by AISC 360, Appendix 3, Table A-3.1  | Shop (3) or field radiographic or Ultrasonic testing        | N | Periodic                        |  |  |
| 5) Fabricator's NDT reports when fabricator performs NDT  | Verify reports  | Y | Each submittal (5)              |  |  |
| 6. Structural steel bolting:  | Shop (3) and field inspection                               |   |                                 |  |  |
| a. Inspection tasks Prior to Bolting (Observe, or perform tasks for each bolted connection, in accordance with QA tasks listed in AISC 360, Table N5.6-1) |   | Y | Observe or Perform as noted (4) |  |  |
| b. Inspection tasks During Bolting (Observe the QA tasks listed in AISC 360, Table N5.6-2)  |   | Y | Observe (4)                     |  |  |

|  |   |   |                |  |  |
|--|---|---|----------------|--|--|
| 1) Pre-tensioned and slip-critical joints  |   |   |                |  |  |
| a) Turn-of-nut with matching markings  |   | Y | Periodic       |  |  |
| b) Direct tension indicator  |   | Y | Periodic       |  |  |
| c) Twist-off type tension control bolt   |   | Y | Periodic       |  |  |
| d) Turn-of-nut without matching markings   |   | Y | Continuous     |  |  |
| e) Calibrated wrench   |   | Y | Continuous     |  |  |
| 2) Snug-tight joints   |   | Y | Periodic       |  |  |
| c. Inspection tasks After Bolting (Perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-3)        |   | Y | Perform (4)    |  |  |
| 7. Inspection of steel elements of composite construction prior to concrete placement in accordance with QA tasks listed in AISC 360, Table N6.1 | Shop (3) and field inspection and testing | N |                |  |  |
| <b>1705.2.2 Steel Construction Other Than Structural Steel</b>   |   |   |                |  |  |
| 1. Material verification of cold-formed steel deck:  |   |   |                |  |  |
| a. Identification markings   | Field inspection                          | Y | Periodic       |  |  |
| b. Manufacturer's certified test reports   | Submittal Review                          | Y | Each submittal |  |  |
| 2. Connection of cold-formed steel deck to supporting structure:   | Shop (3) and field inspection             |   |                |  |  |
| a. Welding   |   | Y | Periodic       |  |  |
| b. Other fasteners (in accordance with AISC 360, Section N6)   |   | Y | Periodic       |  |  |
| 1) Verify fasteners are in conformance with approved submittal   |   | Y | Periodic       |  |  |
| 2) Verify fastener installation is in conformance with approved submittal and manufacturer's recommendations                                     |   | Y | Periodic       |  |  |
| 3. Reinforcing steel   | Shop (3) and field inspection             |   |                |  |  |
| a. Verification of weldability of steel other than ASTM A706   |   | N |                |  |  |

|  |                               |   |   |  |  |
|--|-------------------------------|---|---|--|--|
| b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames, boundary elements of special concrete structural walls and shear reinforcement   |                               | N | Continuous  |  |  |
| c. Shear reinforcement   |                               | N | Continuous  |  |  |
| d. Other reinforcing steel   |                               | N | Periodic  |  |  |
| 4. Cold-formed steel trusses spanning 60 feet or greater   |                               |   |   |  |  |
| a. Verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package  | Field inspection              | Y | Periodic  |  |  |
| <b>1705.3 Concrete Construction</b>  |                               |   |   |  |  |
| 1. Inspection of reinforcing steel installation (see 1705.2.2 for welding)   | Shop (3) and field inspection | Y | Periodic  |  |  |
| 2. Inspection of prestressing steel installation   | Shop (3) and field inspection | N | Periodic  |  |  |
| 3. Inspection of anchors cast in concrete where allowable loads have been increased per section 19 08.5 or where strength design is used   | Shop (3) and field inspection | Y | Periodic  |  |  |
| 4. Inspection of anchors and reinforcing steel post-installed in hardened concrete: Per research reports including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete minimum thickness, anchor embedment and tightening torque | Field inspection              | Y | Periodic or as required by the research report issued by an approved source |  |  |
| 5. Verify use of approved design mix   | Shop (3) and field inspection | Y | Periodic  |  |  |
| 6. Fresh concrete sampling, perform slump and air content tests and determine temperature of concrete  | Shop (3) and field inspection | Y | Continuous  |  |  |
| 7. Inspection of concrete and shotcrete placement for proper application techniques  | Shop (3) and field inspection | Y | Continuous  |  |  |

|  |  |   |   |  |  |
|--|--|---|---|--|--|
| 8. Inspection for maintenance of specified curing temperature and techniques   | Shop (3) and field inspection                        | Y | Periodic                                  |  |  |
| 9. Inspection of prestressed concrete:   | Shop (3) and field inspection                        |   |   |  |  |
| a. Application of prestressing force   |  | N | Continuous                                |  |  |
| b. Grouting of bonded prestressing tendons in the seismic-force-resisting system   |  | N | Continuous                                |  |  |
| 10. Erection of precast concrete members   | Field Inspection                                     | Y | Periodic                                  |  |  |
| a. Inspect in accordance with construction documents   | Field inspection                                     | N | In accordance with construction documents |  |  |
| b. Perform inspections of welding and bolting in accordance with Section 17 05.2   | Field inspection                                     | N | In accordance with Section 17 05.2        |  |  |
| 11. Verification of in-situ concrete strength, prior to stressing of tendons in post tensioned concrete and prior to removal of shores and forms from beams and structural slabs | Review field testing and laboratory reports          | N | Periodic                                  |  |  |
| 12. Inspection of formwork for shape, lines, location and dimensions   | Field inspection                                     | Y | Periodic                                  |  |  |
| 13. Concrete strength testing and verification of compliance with construction documents   | Field testing and review of laboratory reports       | Y | Periodic                                  |  |  |
| <b>1705.4 Masonry Construction</b>   |  |   |   |  |  |
| <b>(A) Level A, B and C Quality Assurance:</b>   |  |   |   |  |  |
| 1. Verify compliance with approved submittals  | Field Inspection                                     | Y | Periodic                                  |  |  |
| <b>(B) Level B Quality Assurance:</b>  |  |   |   |  |  |
| 1. Verification of $f'_m$ and $f'_{AAC}$ prior to construction   | Testing by unit strength method or prism test method | Y | Periodic                                  |  |  |
| <b>(C) Level C Quality Assurance:</b>  |  |   |   |  |  |



|   |  |   |                      |  |  |
|---|--|---|----------------------|--|--|
| 1. Verification of $f'_m$ and $f'_{AAC}$ prior to construction and for every 5,000 SF during construction   | Testing by unit strength method or prism test method | N | Periodic             |  |  |
| 2. Verification of proportions of materials in premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout, as delivered to the project site | Field inspection                                     | N | Continuous           |  |  |
| 3. Verify placement of masonry units  | Field Inspection                                     | N | Periodic             |  |  |
| <b>(D) Levels B and C Quality Assurance:</b>  |  |   |                      |  |  |
| 1. Verification of Slump Flow and Visual Stability Index (VSI) of self-consolidating grout as delivered to the project  | Field testing  | Y | Continuous           |  |  |
| 2. Verify compliance with approved submittals   | Field inspection                                     | Y | Periodic             |  |  |
| 3. Verify proportions of site-mixed mortar, grout and prestressing grout for bonded tendons   | Field Inspection                                     | Y | Periodic             |  |  |
| 4. Verify grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorages  | Field Inspection                                     | Y | Periodic             |  |  |
| 5. Verify construction of mortar joints   | Field Inspection                                     | Y | Periodic             |  |  |
| 6. Verify placement of reinforcement, connectors, and prestressing tendons and anchorages   | Field Inspection                                     | Y | Level B – Periodic   |  |  |
|   |  | N | Level C – Continuous |  |  |
| 7. Verify grout space prior to grouting   | Field Inspection                                     | Y | Level B – Periodic   |  |  |
|   |  | N | Level C – Continuous |  |  |
| 8. Verify placement of grout and prestressing grout for bonded tendons  | Field Inspection                                     | N | Continuous           |  |  |

|  |                  |   |                      |  |  |
|--|------------------|---|----------------------|--|--|
| 9. Verify size and location of structural masonry elements   | Field Inspection | Y | Periodic             |  |  |
| 10. Verify type, size, and location of anchors, including details of anchorage of masonry to structural members, frames, or other construction.      | Field inspection | Y | Level B – Periodic   |  |  |
|  |                  | N | Level C – Continuous |  |  |
| 11. Verify welding of reinforcement (see 1705.2.2)   | Field inspection | N | Continuous           |  |  |
| 12. Verify preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F) | Field inspection | Y | Periodic             |  |  |
| 13. Verify application and measurement of prestressing force   | Field Inspection | N | Continuous           |  |  |
| 14. Verify placement of AAC masonry units and construction of thin-bed mortar joints (first 5000 SF of AAC masonry)                                  | Field inspection | N | Continuous           |  |  |
| 15. Verify placement of AAC masonry units and construction of thin-bed mortar joints (after the first 5000 SF of AAC masonry)                        | Field inspection | N | Level B – Periodic   |  |  |
|  |                  | N | Level C – Continuous |  |  |
| 16. Verify properties of thin-bed mortar for AAC masonry (first 5000 SF of AAC masonry)  | Field inspection | N | Continuous           |  |  |
| 17. Verify properties of thin-bed mortar for AAC masonry (after the first 5000 SF of AAC masonry)  | Field inspection | N | Level B – Periodic   |  |  |
|  |                  | N | Level C – Continuous |  |  |
| 18. Prepare grout and mortar specimens   | Field testing    | Y | Level B – Periodic   |  |  |

|  |                     |   |                      |  |  |
|--|---------------------|---|----------------------|--|--|
|  |                     | N | Level C – Continuous |  |  |
| 19. Observe preparation of prisms  | Field inspection    | Y | Level B – Periodic   |  |  |
|  |                     | N | Level C – Continuous |  |  |
| <b>1705.5 Wood Construction</b>  |                     |   |                      |  |  |
| 1. Inspection of the fabrication process of wood structural elements and assemblies in accordance with Section 17 04.2.5   | In-plant review (3) | N | Periodic             |  |  |
| 2. For high-load diaphragms, verify grade and thickness of structural panel sheathing agree with approved building plans   | Field inspection    | N | Periodic             |  |  |
| 3. For high-load diaphragms, verify nominal size of framing members at adjoining panel edges, nail or staple diameter and length, number of fastener lines, and that spacing between fasteners in each line and at edge margins agree with approved building plans | Field inspection    | N | Periodic             |  |  |
| 4. Metal-plate-connected wood trusses spanning 60 feet or greater: verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package  | Field inspection    | N | Periodic             |  |  |
| <b>1705.6 Soils</b>  |                     |   |                      |  |  |
| 1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.   | Field inspection    | Y | Periodic             |  |  |
| 2. Verify excavations are extended to proper depth and have reached proper material.   | Field inspection    | Y | Periodic             |  |  |
| 3. Perform classification and testing of controlled fill materials.  | Field inspection    | Y | Periodic             |  |  |
| 4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill  | Field inspection    | Y | Continuous           |  |  |
| 5. Prior to placement of controlled fill, observe subgrade and verify  | Field inspection    | Y | Periodic             |  |  |

|  |                              |   |   |  |  |
|--|------------------------------|---|---|--|--|
| that site has been prepared properly   |                              |   |   |  |  |
| <b>1705.7 Driven Deep Foundations</b>  |                              |   |   |  |  |
| 1. Verify element materials, sizes and lengths comply with requirements  | Field inspection             | N | Continuous                                |  |  |
| 2. Determine capacities of test elements and conduct additional load tests, as required  | Field inspection             | N | Continuous                                |  |  |
| 3. Observe driving operations and maintain complete and accurate records for each element  | Field inspection             | N | Continuous                                |  |  |
| 4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element | Field inspection             | N | Continuous                                |  |  |
| 5. For steel elements, perform additional inspections per Section 17 05.2  | See Section 17 05.2          | N | See Section 17 05.2                       |  |  |
| 6. For concrete elements and concrete-filled elements, perform additional inspections per Section 17 05.3  | See Section 17 05.3          | N | See Section 17 05.3                       |  |  |
| 7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge  | Field inspection             | N | In accordance with construction documents |  |  |
| 8. Perform additional inspections and tests in accordance with the construction documents  | Field Inspection and testing | N | In accordance with construction documents |  |  |
| <b>1705.8 Cast-in-Place Deep Foundations</b>   |                              |   |   |  |  |
| 1. Observe drilling operations and maintain complete and accurate records for each element   | Field inspection             | N | Continuous                                |  |  |

|  |                               |   |   |  |  |
|--|-------------------------------|---|---|--|--|
| 2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes | Field inspection              | N | Continuous                                |  |  |
| 3. For concrete elements, perform additional inspections in accordance with Section 17 05.3  | See Section 17 05.3           | N | See Section 17 05.3                       |  |  |
| 4. Perform additional inspections and tests in accordance with the construction documents  | Field Inspection and testing  | N | In accordance with construction documents |  |  |
| <b>1705.9 Helical Pile Foundations</b>   |                               |   |   |  |  |
| 1. Verify installation equipment, pile dimensions, tip elevations, final depth, final installation torque and other data as required.  | Field inspection              | N | Continuous                                |  |  |
| 2. Perform additional inspections and tests in accordance with the construction documents  | Field Inspection and testing  | N | In accordance with construction documents |  |  |
| <b>1705.10.1 Structural Wood Special Inspections For Wind Resistance</b>   |                               |   |   |  |  |
| 1. Inspection of field gluing operations of elements of the main windforce-resisting system  | Field inspection              | N | Continuous                                |  |  |
| 2. Inspection of nailing, bolting, anchoring and other fastening of components within the main windforce-resisting system  | Shop (3) and field inspection | N | Periodic                                  |  |  |
| <b>1705.10.2 Cold-formed Steel Special Inspections For Wind Resistance</b>   |                               |   |   |  |  |
| 1. Inspection during welding operations of elements of the main windforce-resisting system   | Shop (3) and field inspection | N | Periodic                                  |  |  |
| 2. Inspections for screw attachment, bolting, anchoring and other fastening of components within the main windforce-resisting system   | Shop (3) and field inspection | N | Periodic                                  |  |  |

|  |                               |   |                             |  |  |
|--|-------------------------------|---|-----------------------------|--|--|
| <b>1705.10.3 Wind-resisting Components</b>   |                               |   |                             |  |  |
| 1. Roof cladding   | Shop (3) and field inspection | Y | Periodic                    |  |  |
| 2. Wall cladding   | Shop (3) and field inspection | Y | Periodic                    |  |  |
| <b>1705.11.1 Structural Steel Special Inspections for Seismic Resistance</b>   |                               |   |                             |  |  |
| Inspection of structural steel in accordance with AISC 341   | Shop (3) and field inspection | N | In accordance with AISC 341 |  |  |
| <b>1705.11.2 Structural Wood Special Inspections for Seismic Resistance</b>  |                               |   |                             |  |  |
| 1. Inspection of field gluing operations of elements of the seismic-force resisting system   | Field inspection              | N | Continuous                  |  |  |
| 2. Inspection of nailing, bolting, anchoring and other fastening of components within the seismic-force-resisting system                           | Shop (3) and field inspection | N | Periodic                    |  |  |
| <b>1705.11.3 Cold-formed Steel Light-Frame Construction Special Inspections for Seismic Resistance</b>   |                               |   |                             |  |  |
| 1. Inspection during welding operations of elements of the seismic-force-resisting system  | Shop (3) and field inspection | N | Periodic                    |  |  |
| 2. Inspections for screw attachment, bolting, anchoring and other fastening of components within the seismic-force-resisting system                | Shop (3) and field inspection | N | Periodic                    |  |  |
| <b>1705.11.4 Designated Seismic Systems Verification</b>   |                               |   |                             |  |  |
| Inspect and verify that the component label, anchorage or mounting conforms to the certificate of compliance in accordance with Section 17 05.12.3 | Field inspection              | N | Periodic                    |  |  |

|  |                  |   |          |  |  |
|--|------------------|---|----------|--|--|
| <b>1705.11.5 Architectural Components Special Inspections for Seismic Resistance</b>   |                  |   |          |  |  |
| 1. Inspection during the erection and fastening of exterior cladding and interior and exterior veneer  | Field inspection | N | Periodic |  |  |
| 2. Inspection during the erection and fastening of interior and exterior nonbearing walls  | Field inspection | N | Periodic |  |  |
| 3. Inspection during anchorage of access floors  | Field inspection | N | Periodic |  |  |
| <b>1705.11.6 Mechanical and Electrical Components Special Inspections for Seismic Resistance</b>   |                  |   |          |  |  |
| 1. Inspection during the anchorage of electrical equipment for emergency or standby power systems  | Field inspection | N | Periodic |  |  |
| 2. Inspection during the anchorage of other electrical equipment   | Field inspection | N | Periodic |  |  |
| 3. Inspection during installation and anchorage of piping systems designed to carry hazardous materials, and their associated mechanical units | Field inspection | N | Periodic |  |  |
| 4. Inspection during the installation and anchorage of HVAC ductwork that will contain hazardous materials                                     | Field inspection | N | Periodic |  |  |
| 5. Inspection during the installation and anchorage of vibration isolation systems   | Field inspection | N | Periodic |  |  |
| <b>1705.11.7 Storage Racks Special Inspections for Seismic Resistance</b>  |                  |   |          |  |  |
| Inspection during the anchorage of storage racks 8 feet or greater in height   | Field inspection | N | Periodic |  |  |
| <b>1705.11.8 Seismic Isolation Systems</b>   |                  |   |          |  |  |

|   |                                    |   |                |  |  |
|---|------------------------------------|---|----------------|--|--|
| Inspection during the fabrication and installation of isolator units and energy dissipation devices used as part of the seismic isolation system  | Shop and field inspection          | N | Periodic       |  |  |
| <b>1705.12.1 Concrete Reinforcement Testing and Qualification for Seismic Resistance</b>  |                                    |   |                |  |  |
| 1. Review certified mill test reports for each shipment of reinforcement used to resist earthquake-induced flexural and axial forces in reinforced concrete special moment frames, special structural walls, and coupling beams connecting special structural walls | Review certified mill test reports | N | Each shipment  |  |  |
| 2. Verify reinforcement weldability of ASTM A615 reinforcement used to resist earthquake-induced flexural and axial forces in reinforced concrete special moment frames, special structural walls, and coupling beams connecting special structural walls           | Review test reports                | N | Each shipment  |  |  |
| <b>1705.12.2 Structural Steel Testing and Qualification for Seismic Resistance</b>  |                                    |   |                |  |  |
| Test in accordance with the quality assurance requirements of AISC 341  | Shop (3) and field testing         | N | Per AISC 341   |  |  |
| <b>1705.12.3 Seismic Certification of Nonstructural Components</b>  |                                    |   |                |  |  |
| Review certificate of compliance for designated seismic system components.  | Certificate of compliance review   | N | Each submittal |  |  |
| <b>1705.12.4 Seismic Isolation Systems</b>  |                                    |   |                |  |  |
| Test seismic isolation system in accordance with ASCE 7 Section 17.8  | Prototype testing                  | N | Per ASCE 7     |  |  |



|   |                              |   |                            |  |  |
|---|------------------------------|---|----------------------------|--|--|
| <b>1705.13 Sprayed Fire-resistant Materials</b>   |                              |   |                            |  |  |
| 1. Verify surface condition preparation of structural members   | Field inspection             | N | Periodic                   |  |  |
| 2. Verify application of sprayed fire-resistant materials   | Field inspection             | N | Periodic                   |  |  |
| 3. Verify average thickness of sprayed fire-resistant materials applied to structural members   | Field inspection             | N | Periodic                   |  |  |
| 4. Verify density of the sprayed fire-resistant material complies with approved fire-resistant design   | Field inspection and testing | N | Per IBC Section 17 05.13.5 |  |  |
| 5. Verify the cohesive/adhesive bond strength of the cured sprayed fire-resistant material  | Field inspection and testing | N | Per IBC Section 17 05.13.6 |  |  |
| <b>1705.14 Mastic and Intumescent Fire-Resistant Coatings</b>   |                              |   |                            |  |  |
| Inspect mastic and intumescent fire-resistant coatings applied to structural elements and decks   | Field inspection             | N | Periodic                   |  |  |
| <b>1705.15 Exterior Insulation and Finish Systems (EIFS)</b>  |                              |   |                            |  |  |
| 1. Verify materials, details and installations are per the approved construction documents  | Field inspection             | N | Periodic                   |  |  |
| 2. Inspection of water-resistive barrier over sheathing substrate   | Field inspection             | N | Periodic                   |  |  |
| <b>1705.16 Fire-Resistant Penetrations and Joints</b>   |                              |   |                            |  |  |
| 1. Inspect penetration firestop systems   | Field testing                | N | Per ASTM E2174             |  |  |
| 2. Inspect fire-resistant joint systems   | Field testing                | N | Per ASTM E2393             |  |  |
| <b>1705.17 Smoke Control Systems</b>  |                              |   |                            |  |  |
| 1. Leakage testing and recording of device locations prior to concealment   | Field testing                | N | Periodic                   |  |  |
| 2. Prior to occupancy and after sufficient completion, pressure difference testing, flow measurements, and detection and control verification | Field testing                | N | Periodic                   |  |  |
| <b>* INSPECTION AGENTS</b>  |                              |   |                            |  |  |

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

| FIRM  | ADDRESS | TELEPHONE NO. |
|---|---------|---------------|
| 1.  |         |               |
| 2.  |         |               |
| 3.  |         |               |
| 4.  |         |               |
| <p><i>Notes: 1. The inspection and testing agent(s) shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official prior to commencing work. The qualifications of the Special Inspector(s) and/or testing agencies may be subject to the approval of the Building Official and/or the Design Professional.</i></p> <p><i>2. The list of Special Inspectors may be submitted as a separate document, if noted so above.</i></p> <p><i>3. Special Insepctions as required by Section 17 04.2.5 are not required where the fabricator is approved in accordance with IBC Section 17 04.2.5.2</i></p> <p><i>4. Observe on a random basis, operations need not be delayed pending these inspections. Perform these tasks for each welded joint, bolted connection, or steel element.</i></p> <p><i>5. NDT of welds completed in an approved fabricator's shop may be performed by that fabricator when approved by the AHJ. Refer to AISC 360, N7.</i></p> |         |               |
| Are Requirements for Seismic Resistance included in the Statement of Special Inspections?   |         | Yes No        |
| Are Requirements for Wind Resistance included in the Statement of Special Inspections?  |         | Yes No        |
| DATE:   |         |               |

END OF SECTION 01 4000

SECTION 01 45 16.01  
CONCRETE TESTING

PART 1 - GENERAL

1.01 Work Included

This work includes requirements for concrete, concrete submittals, and testing.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ACI PRC-211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- B. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- D. ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- E. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
- F. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete
- G. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- H. ASTM C595 – Standard Specification for Blended Hydraulic Cements
- I. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- J. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- K. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- L. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- M. ASTM E29 – Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- N. Michigan Department of Transportation 2020 Standard Specifications for Construction
- O. Michigan Test Methods (MTM)
- P. Michigan Department of Transportation Qualified Products List

### 1.03 Related Work

- A. Section 32 13 00 – Concrete Curb and Gutter, Sidewalk, and Miscellaneous Pavement

### 1.04 Submittals

- A. Prior to beginning construction, the Contractor shall submit the name and plant location of the proposed NRMCA certified concrete supplier for the project.
- B. Prior to beginning construction, the Contractor shall submit mix designs for the proposed concrete mixtures proposed for use on the project for the Owner to review.
- C. The Contractor shall submit a Quality Control Testing plan to be approved by the Owner.

### 1.05 Quality Assurance and Quality Control

- A. The Contractor will be responsible for Quality Control Testing and the Owner will be responsible for Quality Assurance Testing.
- B. Concrete Testing
  - 1. The temperature of concrete will be determined in accordance with ASTM C1064.
  - 2. Samples of concrete for testing will be obtained in accordance with ASTM C172.
  - 3. The slump of concrete will be determined in accordance with ASTM C143.
  - 4. The air content of concrete will be measured in accordance with ASTM C231.
  - 5. Concrete cylinders for compressive testing will be made in accordance with ASTM C31. The Owner and Contractor shall use the same size cylinder for test specimens. Four-inch cylinders are preferred, as allowed by ASTM C31.
  - 6. The compressive strength of concrete will be determined in accordance with ASTM C39.

## PART 2 - PRODUCTS

### 2.01 Mix Design and Documentation

Design concrete mixtures shall meet the requirements specified in Table 1. The Contractor shall provide the grade of concrete for the section number reference application specified in Table 1, or as specified in the contract. The Contractor shall submit a request variance, in writing, when proposing a mix design that exhibits temperature, slump, or air content other than those specified. This submittal shall include the proposed mix design, Job Mix Formula (JMF), and associated trial batch verification test data. Do not use a grade of concrete with a lower specification limit (LSL) 28-day compressive strength less than what is designated for the application.

Blended cement meeting the requirements of ASTM C595 Type IL is permitted.

Secure prior approval from the Owner to use concrete intended for early opening to traffic to facilitate driveway gaps or other features necessary for required local access.

Unless otherwise specified in the contract, set accelerating admixtures are prohibited.

Unless otherwise specified in the contract, do not exceed 40 percent replacement of the Portland cement in the concrete mixture with slag cement (Grade 100 minimum) or fly ash. Do not exceed 40 percent total replacement of the Portland cement if both slag cement and fly ash are used in the concrete mixture.

Use the combined weight of all cementitious materials to determine compliance with the maximum water-cementitious ratio and cementitious material content requirements specified in Table 1.

| <b>Table 1: Minimum Mix Design Requirements for Concrete</b> |        |                       |              |              |              |
|--|--------|-----------------------|--------------|--------------|--------------|
|  |        | <b>Concrete Grade</b> |              |              |              |
|  |        | <b>3,000</b>          | <b>3,500</b> | <b>4,000</b> | <b>4,500</b> |
| Compressive strength (psi)                                   | 7-day  | 2,200                 | 2,600        | 3,000        | 3,200        |
|  | 28-day | 3,000                 | 3,500        | 4,000        | 4,500        |
|  | 70%    | 2,100                 | 2,450        | 2,800        | 3,150        |
| Flexural Strength (psi)                                      | 7-day  | 500                   | 550          | 600          | 625          |
|  | 28-day | 600                   | 650          | 700          | 750          |
|  | 70%    | 420                   | 455          | 490          | 525          |
| Slump (inch)   |        | (c)-(f)               | (c)-(k)      | (l)-(n)      | (d)-(f)      |
| Cementitious material content (lb/cyd)                       |        | 489-517               | 517-611 (o)  | 517-611      | 517-658      |
| Class of coarse aggregate                                    |        | (p)-(r)               |              |              |              |
| Maximum w/cm ratio   |        | 0.45                  |              |              |              |
| Air content range  |        | 5.5-8.5%              |              |              |              |

- a. Reserved for future use.
- b. Reserved for future use.
- c. 0- to 3-inch slump for mixtures for pavements.
- d. 0- to 3-inch slump without admixtures or with Type A or D admixture.
- e. 0- to 6-inch slump after the addition of Type MR admixture.
- f. 0- to 7-inch slump after the addition of Type F or G admixture.
- g. 3- to 7-inch slump for tremie applications without admixture or with Type A or D admixture.
- h. 3- to 7-inch slump for tremie applications after the addition of Type MR admixture.
- i. 3- to 8-inch slump for tremie applications after the addition of Type F or G admixture.
- j. 6- to 8-inch slump for dry placed drilled shafts.
- k. 7- to 9-inch slump for wet placed drilled shafts.
- l. 3- to 5-inch slump without admixtures or with Type A or D admixture.
- m. 3- to 6-inch slump after the addition of Type MR admixture.
- n. 3- to 7-inch slump after the addition of Type F or G admixture.
- o. For concrete pavement repair mixtures, use 658 lb/cyd of cement when the weather is forecast to be above 50 degrees Fahrenheit or 752 lb/cyd when the weather is forecast to be 50 degrees Fahrenheit or below.
- p. Use aggregates only from geologically natural sources for pavement, shoulder, miscellaneous pavement (including ramps), concrete pavement overlay, bridge approach slab, structural concrete, drilled shaft, bridge railing, and bridge sidewalk applications.

- q. Unless otherwise required, use Coarse Aggregate 6AA or 17A for exposed structural concrete in bridges, retaining walls, and pump stations.
- r. The flexural and compressive strengths are not part of the specifications but are listed for informational purposes only and are the minimum strengths anticipated for the mix proportions specified for the various grades of concrete when cured under standard conditions.

#### A. Alkali-Silica Reactivity

Provide documentation to the Owner that the concrete mixture does not present the potential for excessive expansion caused by alkali-silica reactivity (ASR). Provide current ASR test results (valid for two years from completion of testing), for the fine aggregate that is proposed to be used in the concrete from an independent testing laboratory proficient in ASR testing. The independent testing laboratory must certify, in writing, that all testing was conducted in accordance with the designated standard test procedures described herein. Test results must conform to the specified criterion for one of the following standard test methods. Use the Rounding Method described in ASTM E29 when determining significant digits for reporting expansion test results.

##### 1. Method 1 – ASTM C1260 Mortar Bar Test

If the expansion of the mortar bars is less than 0.10 percent (rounded to the nearest 0.01 percent) at 14 days of immersion, the fine aggregate is considered non-deleterious to ASR and may be used in the concrete without the need for ASR mitigation.

##### 2. Method 2 – ASTM C1293 Concrete Prism Test

- a. If the expansion of concrete prisms is not greater than 0.040 percent (rounded to the nearest 0.001 percent) after 1 year, the fine aggregate is considered non-deleterious to ASR and may be used in the concrete without the need for ASR mitigation.
- b. If the expansion of concrete prisms is greater than 0.040 percent, but not exceeding 0.120 percent (rounded to the nearest 0.001 percent) after 1 year, the fine aggregate is considered moderately deleterious to ASR and mitigation is required, as follows. A low-alkali cement with  $\text{Na}_2\text{O}$  equivalent alkalis ( $\text{Na}_2\text{O} + 0.658 \times \text{percent K}_2\text{O}$ ) not exceeding 0.60 percent must be used in the concrete mixture to mitigate the potential for ASR. Slag cement or fly ash may be used in conjunction with the low-alkali cement. The total alkali content for the cementitious materials combination must not exceed 3 pounds per cubic yard of  $\text{Na}_2\text{O}$  equivalent.

##### 3. Method 3 – ASTM C1567 Accelerated Mortar Bar Test

If no previous test data are available for the fine aggregate that shows it is resistant to ASR using either Method 1 or 2 above, replace 25 percent to 40 percent of the Portland cement in the concrete mixture with slag cement (Grade 100 minimum) or fly ash. A blended cement meeting the requirements of ASTM C595 containing Portland cement and slag cement or fly ash may also be used.

Demonstrate the ability of the fly ash or slag cement to control the deleterious expansion caused by ASR by molding and testing mortar bars according to the standard test method described in ASTM C1567, using the mix proportions and constituent sources for both the aggregates and the cementitious materials that will be used for the project. Make at least three test specimens for each cementitious materials-aggregate combination. If the

average of 3 mortar bars for a given cementitious materials-aggregate combination produces an expansion less than 0.10 percent (rounded to the nearest 0.01 percent) at 14 days of immersion, the JMF associated with that combination will be considered non-deleterious to ASR. If the average expansion is 0.10 percent (rounded to the nearest 0.01 percent) or greater, the JMF associated with that combination will be considered not sufficient to control the deleterious expansion caused by ASR and the JMF will be rejected.

The Owner will not approve the use of the JMF if the expansion exceeds the respective threshold limits for the respective ASTM test method used.

#### B. Mix Documentation

Provide mix design and accompanying JMFs using the methods of verification included in this specification. Include sufficient information on constituent materials and admixtures, along with trial batch verified physical properties of the fresh concrete, mix proportions per cubic yard for all constituents, and compressive strength test results necessary to allow the Owner to fully evaluate the expected performance of the concrete mixture.

Submit mix design and JMF; include accompanying documentation. List the source of materials, bulk density (unit weight) of coarse aggregate (rodding procedure or shoveling procedure), absorption of aggregates, relative density (specific gravity) of aggregates, aggregate correction factors, batch weights, and project specific or historical laboratory test data. Include the recorded air content of fresh concrete using the same admixture and cementitious material sources to be used in the production of the concrete for the project. A JMF will be approved only if all of the minimum mix design requirements specified in the contract have been met. Use of the MDOT Job Mix Formula Concrete Field Communication Form (MDOT Form Number 1976) is encouraged.

##### 1. Job Mix Formula

Select proportions for concrete mixtures according to ACI Standard 211.1. The volume (oven-dry-rodded) of coarse aggregate per unit volume of concrete must be 65 percent, minimum.

Four methods of verification of proposed JMF are acceptable.

##### a. Method 1 – Trial Batches

Verification of JMF is based on trial batches with the same materials and proportions proposed for use on the project. Prepare at least one trial batch for each mix design in sufficient time before starting concrete placement to allow for review, according to subsection 2.01.A of this specification. Provide the results of temperature, slump, density (unit weight), air content of fresh concrete, 28-day compressive strength, and age of concrete at the time of strength testing, for a minimum of 3 independent samples. All samples may be taken from a single trial batch for a mix design, provided the trial batch is at least 4 cubic yards in volume. For JMF trial batch verification purposes only, 7-day compressive strength test results which report at least 70 percent of the specified 28-day lower specification limit will be sufficient documentation, in lieu of 28-day compressive strengths. The average of at least two strength test specimens represents one compressive strength sample test result for

each independent sample. Provide the necessary ASR documentation as described in subsection 2.01.A of this specification.

b. Method 2 – Same Mix

Verification of JMF is based on experience with the same mix design, JMF, and the same materials. Provide the results of temperature, slump, density (unit weight), air content of fresh concrete, 28-day compressive strength, and age of concrete at the time of strength testing, for a minimum of 3 independent samples produced within the previous 12 months. The average of at least two strength test specimens represents one compressive strength sample test result for each independent sample. Do not substitute material types or sources, including admixtures or cementitious materials, nor change mix proportions in the JMF. Provide the necessary ASR documentation as described in subsection 2.01.A of this specification.

c. Method 3 – Similar Mix

Verification of JMF is based on requirements described in Method 2 above. Substitution of coarse aggregate source is permitted if the new source is of the same geologic type as the original aggregate, and conforms to the specification requirements for the application. Substitution of fine aggregate is permitted only if the new source has been tested for ASR. Provide the necessary ASR documentation as described in subsection 2.01.A of this specification.

Provide the supporting laboratory trial batch documentation and accompanying calculations showing how the mix proportions in the JMF were adjusted, based on the documented differences in relative density (specific gravity), bulk density (unit weight), and absorption of the substituted aggregate sources, to produce a theoretical yield of 100 percent and the required fresh concrete properties.

d. Method 4 – Annual Verification

At the Owner's option, verification may be accepted annually for a concrete plant rather than on a project basis provided the sources and proportions of the constituent materials, including cementitious materials and source and types admixtures, do not change. If the project is the continuation of work in progress during the previous construction season and written certification is submitted to the Owner that materials from the same source and with the same mixture properties are to be used, the Owner may waive the requirement for annual renewal verification of the JMF for the project. Provide the necessary ASR documentation as described in subsection 2.01.A of this specification.

C. Concrete Testing and Break Results

The Contractor shall submit a sample form that will be used to document concrete testing and break results, prior to start of construction, to be approved by the Owner. The Contractor shall submit the approved form documenting results within three days of concrete testing.

PART 3 - EXECUTION

3.01 Sampling and Testing

The Owner shall verify the Contractor's daily startup sampling and testing of temperature, slump,



and air content of fresh concrete on the first load; conduct QA sampling and testing; monitor Contractor adherence to the QC plan; and inspect field placed materials in such a manner as to ensure that all concrete for the project is represented at a rate determined by the Owner.

A. The following ASTM test methods will apply.

1. C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
2. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
4. C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
5. C172 – Standard Practice for Sampling Freshly Mixed Concrete
6. C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

B. Sampling

Sampling and testing shall be conducted by the Contractor during placement of the concrete. The Contractor shall take a random sample at a rate of approximately once per 50 cubic yards, based on the anticipated total quantity of concrete to be placed and site conditions, with a minimum of 1 sampling for each day of production per mix design. The sampling rate may be increased by the Owner if project conditions warrant increased testing. A minimum of 3 cylinders shall be taken for each test (one 7-day break and two 28-day breaks).

The Contractor may elect to provide early concrete cylinder breaks. The Contractor is responsible for all additional costs and materials for providing early concrete cylinder breaks. Results for early cylinder breaks shall be submitted to and approved by the Owner prior to beginning next related work item.

The Owner shall perform Quality Assurance testing, on an as-needed basis, at a rate determined by the Owner.

Samples will be taken from the concrete at the location as close to its final placement into the forms or on the grade as practical. If sampling from the discharge of the haul unit, the sample will be taken from approximately the middle  $\frac{1}{3}$  of the load.

Samples for acceptance will not be taken at the concrete production facility (batch plant), nor prior to discharge from a concrete pump (excluding tremie seal placement applications).

C. Small Incidental Quantities

1. Reduced Quality Control (QC) for Small Incidental Quantities.

Reduced levels of on-site QC testing for concrete may be considered for small incidental quantities. Unless approved by the Owner, multiple small incidental quantities, including ones that are placed consecutively throughout the project on the same day, are not eligible for reduced QC consideration if the total plan quantity of concrete for the item

exceeds 100 cubic yards. Include details for reduced QC testing and oversight in the approved QC plan in accordance with following:

- a. The small incidental quantity of concrete will be limited to a single day's concrete placement of a maximum 20 cubic yards;
  - b. The small incidental quantity of concrete is not an integral part of a structural load-bearing element;
  - c. The Owner has received written certification from the Contractor that the concrete supplier has a current QC plan in place and available for review upon request by the Owner;
  - d. The concrete supplier employs an MCA-certified Michigan Concrete Technician Level II available at the plant or on call during concrete placement to validate and authorize modifications to the concrete JMF;
  - e. Prior to the first concreting operation, concrete representing the JMF for the small incidental quantity has been sampled and tested by an MCA-certified Michigan Concrete Technician Level I or Level II to verify that, historically, the JMF produced a concrete mixture meeting the minimum requirements for density (unit weight), slump, air content, and strength. Annual verification may be acceptable provided there are no changes to the material types or sources, including the cementitious materials and admixtures;
  - f. The Owner verifies that the temperature, slump, and air content conform to specification requirements at the start of the day's concreting operation associated with the small incidental quantity; and
  - g. The Owner is notified a minimum of 24 hours prior to concrete placement.
2. Reduced Quality Assurance (QA) for Small Incidental Quantities.
- At the discretion of the Owner, daily 28-day compressive strength QA test cylinders for small incidental quantities of concrete may not be required provided QA test cylinders representing the same JMF were sampled and molded at least once during the same week.

### 3.02 Suspension Limits

If during the pour the concrete is found to be out of the specifications in Table 2, then the pour shall be stopped until concrete can be provided that meets the project specifications. The Owner will not pay for items placed with concrete that does not meet the following specifications.

| Table 2                                   |                                 |
|---|---------------------------------|
| Quality Characteristic                    | Suspension Limits               |
| Air Content (percent)                     | <5.0 or >9.0                    |
| Air Content Loss (percent)                | Greater than 1.5                |
| Concrete Temperature (degrees Fahrenheit) | <45 or >90 at time of placement |
| Slump                                     | See Table 1                     |

### 3.03 Acceptance

Concrete items will be accepted based on the criteria in the items specification; concrete was placed within the limits of Table 2 and the average of the corresponding 28-day test cylinders being above the design strength.

\*\*\*END OF SECTION\*\*\*

SECTION 01 45 16.02  
DENSITY AND AGGREGATE TESTING

PART 1 - GENERAL

1.01 Work Included

This work includes material testing of soil, aggregates, stabilized mixtures, and pulverized pavement mixtures.

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Department of Transportation Density Testing and Inspection Manual
- C. Michigan Department of Transportation Procedures for Aggregate Inspection
- D. Michigan Test Methods (MTM)

1.03 Related Work

- A. Section 01 74 50 – Cleanup and Restoration
- B. Section 31 23 01 – Excavating, Filling, and Grading
- C. Section 31 23 02 – Excavating and Backfilling for Utility Construction
- D. Section 32 11 16 – Granular Subbase
- E. Section 32 11 23 – Aggregate Base
- F. Section 32 11 26 – HMA Base Crushing and Shaping
- G. Section 32 12 16 – HMA Paving
- H. Section 32 13 00 – Concrete Curb and Gutter, Sidewalk, and Miscellaneous Pavement
- I. Section 33 11 00 – Water Main
- J. Section 33 31 00 – Sanitary Sewer
- K. Section 33 44 00 – Storm Sewers
- L. Section 33 46 16 – Underdrains

1.04 Quality Assurance and Quality Control

- A. Soil and Aggregate Density Testing
  - 1. The Contractor is responsible for all quality control density testing on this project. The Owner will complete quality assurance density testing at a random rate.
- B. Sand and Aggregate Gradation

The Contractor is to supply sand and aggregates in the Michigan Department of Transportation gradations, as specified by the project specifications.

Contractors are encouraged to use “prequalified” Michigan Department of Transportation aggregate sources. If the Contractor elects to use a non-prequalified source, then the Contractor shall be responsible for supplying the Owner with Sieve Analysis (MTM109) and Loss by Washing (MTM108) at the following rates:

|                                    |                          |
|------------------------------------|--------------------------|
| Coarse Aggregates                  | 1 per 1,000 tons         |
| Dense-Graded Aggregates            | 1 per 1,000 tons         |
| Open-Graded Aggregates             | 1 per 1,000 tons         |
| Granular Material Class I          | 1 per 1,000 tons         |
| Granular Material Class II and IIA | 1 per 3,000 cubic yards  |
| Granular Material Class III        | 1 per 10,000 cubic yards |
| Fine Aggregate                     | 1 per 1,000 tons         |

All Sieve Analysis and Loss by Washing reports shall be signed and sealed by a Professional Engineer.

#### 1.05 Job Conditions

##### A. Access for Testing

The Contractor shall provide the Owner safe access for testing technicians to complete any required testing. Reasonable time for testing shall be allowed by the Contractor.

##### B. Safety

The Contractor is responsible for conducting operations in a safe and orderly manner and in conformance with MIOSHA P.A. 154.

### PART 2 - PRODUCTS

#### 2.01 Submittals

The Contractor shall submit a Quality Control Testing plan to be approved by the Owner. The Quality Control Testing plan shall include, at a minimum, the company performing the testing, certifications, equipment calibration reports, frequency of testing, procedure for notifying the Owner if tests fail to meet specifications, corrective action plan, and sample form that will be used to document material testing results. The Contractor shall submit the approved form documenting results within three days of material testing.

### PART 3 - EXECUTION

#### 3.01 Minimum Percent of Compaction for Aggregates

The following are a minimum percent compaction for typical items of work. Note: Higher percent compaction may be required for specific items of work, see specifications for those items.

##### A. Original Ground

|   |            |
|---|------------|
| Road Embankment Areas                             | 90 percent |
| Bridges – within the limits as shown on the plans | 95 percent |

|   |                                    |
|---|------------------------------------|
| <b>B. Cut Areas</b>   |                                    |
| Cuts requiring Sand Subbase   | 95 percent                         |
| Cuts not requiring Sand Subbase   | 95 percent                         |
| Subgrade for HMA Base, Aggregate Base, and Concrete Widening  | 95 percent                         |
| Trenches for under HMA Shoulders  | 98 percent*                        |
| <b>C. Embankments and Backfill</b>  |                                    |
| Regular   | 95 percent*<br>(within top 3 feet) |
| Abutments with Piling   | 95 percent                         |
| Abutments without Piling  | 100 percent                        |
| Foundation Undercut Backfill  | 100 percent                        |
| Backfill for Bridges, Culverts, Utilities, Manholes, Catch Basins,<br>Edge Drains, and Subgrade Undercuts | 95 percent                         |
| Foundations and Miscellaneous Structures  | 95 percent                         |
| <b>D. Pavement Structure</b>  |                                    |
| Subbase   | 95 percent*                        |
| Subbase for Slope Paving  | 90 percent                         |
| Aggregate Base under Concrete Pavement  | 95 percent*                        |
| Aggregate Base under HMA Pavement   | 98 percent*                        |
| Pulverized HMA Aggregate Base   | 98 percent                         |
| Recycled Concrete Aggregate Base – under Concrete Pavement  | 95 percent                         |
| Recycled Concrete Aggregate Base – under HMA Pavement   | 98 percent                         |
| Aggregate Base – Sleeper Slab and Bridge Approach   | 98 percent                         |
| Shoulders – Class I   | 98 percent*                        |
| Shoulders – Class II, III, and IV   | 95 percent*                        |
| OGDC – used under Concrete and HMA Pavement   | 95 percent*                        |
| OGDC – used under Concrete and HMA Pavement (recycled material)   | 98 percent*                        |
| * May NOT exceed optimum moisture   |                                    |

### 3.02 HMA Density

The density control target, “Theoretical Maximum Density” (TMD) for HMA shall be calculated using the Gmm from the Contractors approved HMA mix design.  $TMD = Gmm \times 62.4$ .

|                     |                          |
|---------------------|--------------------------|
| HMA Base Course     | 92 percent to 98 percent |
| HMA Leveling Course | 92 percent to 98 percent |
| HMA Top Course      | 92 percent to 98 percent |

The HMA layer must meet the required density target before the succeeding lift or traffic is placed on the pavement.

### 3.03 Testing Frequency

Each layer must be tested and meet compaction requirements before the succeeding layer is placed. The Owner will test at a rate that is warranted for field conditions and Contractor means and methods. The list of frequencies below are minimums.

|  |  |
|--|--|
| Subgrade                                 | 1 test per 500 feet per width of 24 feet or less           |
| Embankment                               | 1 test per 1,000 cubic yards of material<br>and every lift |
| Subbase                                  | 1 test per 500 feet per width of 24 feet or less           |
| Backfill                                 | 1 test per 300 cubic yards of material                     |
| Aggregate Base Course                    | 1 test per 500 feet per width of 24 feet or less           |
| HMA Mixtures                             | 1 test per 500 feet per width of 24 feet or less           |
| Shoulders                                | 1 test per 1,000 feet each side                            |
| Sleeper Slab                             | 1 test per bridge approach per stage                       |
| Foundations and Miscellaneous Structures | 1 test per 1-foot lift or per 300 cubic yards              |
| Trenching                                | 1 test per 1,000 feet each side                            |

### 3.04 Compaction Efforts

The Contractor shall continue to make compaction efforts to obtain the minimum standards given within this specification upon notification of a failing test. A passing test is required at every location of a failing test prior to starting the next related item of work.

\*\*\*END OF SECTION\*\*\*

SECTION 01 55 26  
MAINTAINING TRAFFIC

PART 1 - GENERAL

1.01 Work Included

The Contractor shall execute the work in a manner such that traffic is maintained and access is provided to all residences, businesses, and commercial establishments.

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Manual on Uniform Traffic Control Devices
- C. Maintaining Traffic Typical, 110-TR-NFW-2L, for Lane Closure Utilizing Traffic Regulators on a 2-Lane Undivided Roadway

1.03 Related Work

- A. Section 01 57 26 – Dust Control

PART 2 - PRODUCTS

2.01 Signing

Signing and barricading shall be provided by the Contractor in accordance with the details on the plans, the Michigan Manual on Uniform Traffic Control Devices, the Michigan Department of Transportation Maintaining Traffic Typicals, and the requirements of the road agency. Barricades left in place after dark shall be lighted.

The Contractor shall submit a plan of the proposed traffic control to the Owner for review.

PART 3 - EXECUTION

3.01 Maintain Access to Jefferson Avenue

Traffic on Jefferson Avenue shall be maintained using a single-lane closure utilizing traffic regulators during construction of water services.

3.02 Maintain Access to all Properties

It shall be the Contractor's responsibility to notify residents or occupants of property along the project of temporary closures of driveways or roads, in writing, a minimum of 24 hours in advance of closure. Contractor shall submit draft notice to Owner for review and approval two work days prior to issuing it. Sufficient advance warning shall be provided to allow notification of all affected parties. A copy of the written notification shall be provided to the Owner.

The duration of any closure shall be limited to the minimum length of time necessary to complete



the particular task requiring the closure. In no case shall a closure extend overnight, unless approved by the Owner.

Upon completion of pipe installation or other work requiring a closure of a driveway, road, or sidewalk, the area shall be backfilled and regraded to meet adjacent grades. A temporary gravel surface shall be provided and maintained by the Contractor. The gravel shall meet the requirements of 23A series aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction. Recycled HMA may also be utilized after approval of material by the Owner. The gravel shall be placed to a depth of at least 8 inches.

### 3.03 Protection of Hazardous Areas

Excavation and hazardous areas shall be protected by barricades or snow fence. Barricades left in place at night shall be lighted.

### 3.04 Corrective Action

If in the Owner's opinion inadequate protection or maintenance of traffic is provided, they will attempt to contact the Contractor and notify them of the deficiency. If the Contractor cannot be notified or fails to make prompt corrections, the Owner may authorize that said deficiencies be corrected by others. The cost of making such corrections will be charged to the Contractor.

\*\*\*END OF SECTION\*\*\*

SECTION 01 57 26  
DUST CONTROL

PART 1 - GENERAL

1.01 Work Included

The Contractor shall provide and maintain adequate measures to control dust from the project area.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM D98 – Standard Specification for Calcium Chloride
- B. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 55 26 – Maintaining Traffic
- B. Section 31 23 01 – Excavating, Filling, and Grading
- C. Section 31 23 02 – Excavating and Backfilling for Utility Construction
- D. Section 31 25 00 – Soil Erosion and Sedimentation Control

PART 2 - PRODUCTS

2.01 Materials

- A. Dust palliative shall be calcium chloride conforming to ASTM D98, except as modified here: Calcium chloride solids shall have a minimum concentration of 77 percent  $\text{CaCl}_2$ , and may be of any gradation provided that all particles will pass a  $\frac{3}{8}$ -inch sieve, and that less than 5 percent pass a No. 30 sieve. Calcium chloride liquid must be furnished in solution with a concentration of 33, 35, or 38 percent  $\text{CaCl}_2$ .

At the time of delivery, the supplier shall be provided a delivery report with the following information:

1. The volume in gallons or weight of solution delivered, or the weight of solids delivered.
2. The concentration of solids or solution delivered, expressed as the percent of  $\text{CaCl}_2$ .
3. The equivalent tons of calcium chloride,  $\text{CaCl}_2$ . The equivalent weight of calcium chloride shall be determined in accordance with Table 922-2, of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

## PART 3 - EXECUTION

### 3.01 Requirements for Dust Control Measures

The Contractor shall provide adequate dust control measures to prevent dust from the construction area from being a health or safety hazard or a nuisance. The Contractor is responsible for control of dust from the construction area, even if the dust is caused by traffic other than the Contractor's operations.

The Contractor shall maintain the dust control measures through the life of the project.

When, in the Owner's opinion, the Contractor's measures for the control of dust are inadequate, the Owner will provide notice to the Contractor to take such measures as necessary to control the dust. If the Contractor fails to provide for the required controls, the Owner may make arrangements for providing dust control measures by another party, and deduct the cost thereof from the Contractor's earnings.

### 3.02 Application

Water or dust palliative shall be uniformly applied to exposed soil areas which may be the source of dust. The application(s) shall be repeated as necessary to control dust emanating from the project area. If water is used, it shall be applied at a rate to not cause mud to be tracked out of the project limits.

\*\*\*END OF SECTION\*\*\*

SECTION 01 71 13  
MOBILIZATION

PART 1 - GENERAL

1.01 Work Included

Mobilization consists of preparatory work and operations, including but not limited to the following:

- A. The movement of people, equipment, and materials to the project site;
- B. The establishment of the Contractor's facilities to work on the project (offices, storage yards, borrow and disposal sites, etc.);
- C. Expenses incurred prior to beginning work on specific contract pay items;
- D. Pre-construction costs (not bidding costs) which are direct costs to the project, rather than direct costs to specific pay items.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Mobilization

Following Notice of Award, the Contractor shall expeditiously prosecute such work necessary for execution of the contract.

Following Notice to Proceed, the Contractor shall commence such work necessary to prepare for the beginning work on the project.

\*\*\*END OF SECTION\*\*\*

SECTION 01 71 23.16  
CONSTRUCTION STAKING BY CONTRACTOR

PART 1 - GENERAL

1.01 Work Included

The Contractor is responsible to provide all staking and layout necessary for construction of the project, including contracting D&M Site, Inc. to obtain horizontal coordinate system information.

1.02 Notifications

In the event that it appears there is an error or contradiction between plan grades, construction stakes, and/or actual conditions, the Contractor shall notify the Owner immediately.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Requirements

The Contractor is responsible to provide such layout and control work as may be required for construction of the proposed improvements.

The Contractor shall provide workers competent in the layout and control work necessary. The Contractor shall provide the equipment and materials necessary for establishing the necessary control and layout.

Pipelines, 8 inches or larger that are to be laid at a uniform grade, shall be laid using a laser for alignment control.

3.02 Plan Grades and Alignment

The horizontal alignment of manholes and drainage structures will be from the center of casting, unless otherwise noted.

Final casting elevation for drainage structures and manholes shall be determined by the Owner after grading is completed.

\*\*\*END OF SECTION\*\*\*

SECTION 01 74 50  
CLEANUP AND RESTORATION

PART 1 - GENERAL

1.01 Work Included

The Contractor shall restore areas disturbed by construction activities to a condition reasonably close to their condition before the project, unless shown otherwise on the plans. Restoration work should be performed as soon as possible after construction work is completed in a particular area.

Upon the completion of work in an area, all excess materials, debris, equipment, and similar items shall be removed from the project area by the Contractor and disposed of properly.

1.02 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 31 25 00 – Soil Erosion and Sedimentation Control
- C. Section 32 11 23 – Aggregate Base
- D. Section 32 12 16 – HMA Paving
- E. Section 32 13 00 – Concrete Curb and Gutter, Sidewalk, and Miscellaneous Pavement
- F. Section 32 92 00 – Turf Establishment

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Restoration

Unless otherwise provided, aggregate surfaces, HMA pavements, and concrete pavements shall be restored by construction of similar replacement surfaces. Aggregate surfaces shall be replaced with the materials and thicknesses described in the specification for aggregate surfaces or as shown on the drawings. HMA pavement shall be replaced with the cross section(s) shown on the plans and in accordance with Section 32 12 16 – HMA Paving. Concrete pavement shall be replaced with pavement in accordance with Section 32 13 00 – Concrete Curb and Gutter, Sidewalk, and Miscellaneous Pavement.

Turf areas shall be restored by re-establishing the turf as described in Section 32 92 00 – Turf Establishment. All areas disturbed by construction that are not to be surfaced with aggregate or pavement shall be restored with turf, unless otherwise directed.

Mailboxes, fences, signs, ornaments, and similar items shall be replaced at the completion of construction. Posts shall be installed plumb. Items that are lost or stolen shall be repaired or replaced at the Contractor's expense. Repairs or replacements shall meet the Owner's approval.

### 3.02 Temporary Restoration of Driving Surfaces

Where a pavement or gravel surface is removed as a result of construction activities, a temporary surface shall be provided and maintained by the Contractor until the permanent surface is provided. Unless otherwise directed, the temporary surface shall be 8 inches of aggregate compacted according to Section 01 45 16.02 – Density and Aggregate Testing and graded to meet the adjacent, remaining surfaces. Aggregate shall meet the requirements of Series 23A as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction. Recycled HMA may also be utilized after approval of material by the Owner.

The Contractor shall regrade the temporary surface and add additional aggregate periodically, as necessary, to maintain them in a relatively smooth condition.

\*\*\*END OF SECTION\*\*\*

SECTION 02 32 19  
EXPLORATORY EXCAVATION

PART 1 - GENERAL

1.01 Work Included

This work consists of providing all labor, equipment, and materials required to excavate an exploratory hole to expose an existing sewer or water pipe to verify location, material, and size of pipe in accordance with Section 205 of the Michigan Department of Transportation 2020 Standard Specifications for Construction. Perform this work as directed by the Owner.

PART 2 - PRODUCTS

2.01 Materials

Excavated material from the hole may be used to backfill the trench unless the Owner directs otherwise.

PART 3 - EXECUTION

3.01 Excavation

Contact the MISS DIG system a minimum of three full working days prior to beginning this work. Excavate exploratory hole, as required, to gather necessary information on the existing utility and as directed by the Owner in the field. In order to not damage the existing utility, portions of the exploratory hole may need to be hand excavated. Any damaged utilities shall be repaired at the Contractor's expense.

The Contractor shall provide sufficient barricades and fences to protect pedestrians and vehicles from hazardous areas.

\*\*\*END OF SECTION\*\*\*



## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### 1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at [Project site] <Insert location>.
  - 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.
  - 5. Review areas where existing construction is to remain and requires protection.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. 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. 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. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- B. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

#### 1.7 FIELD CONDITIONS

- A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- B. 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 suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

- C. 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 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations if utilities are disturbed as part of the work.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to perform an engineering survey of 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 building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
  - 1. Inventory and record the condition of items to be removed and salvaged.
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of

measurements, materials, and construction details required to make exact reproduction.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.3 PROTECTION

- A. Temporary Protection: 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.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- 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. 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.
- B. 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.
- C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
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.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075419, for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

Insert other specific disposal, cleanup, or removal requirements to suit Project.

- A. Remove demolition waste materials from Project site.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

### 3.7 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.

### 3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: As indicated in Drawings.
- B. Remove and Salvage: As indicated in Drawings.
- C. Remove and Reinstall: As indicated in Drawings.
- D. Existing to Remain: As indicated in Drawings.

END OF SECTION 024119

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
  - 2. Section 033543 "Polished Concrete Finishing" for flatness and levelness ratings for interior slabs and polished concrete finishing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

#### 1.5 PREINSTALLATION MEETING

- A. Preinstallation Conference: Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with concrete materials, installation, and finishes, including polishing, to be present, including:
  - 1. Contractor's Superintendent
  - 2. Independent testing agency responsible for concrete design mixtures.
  - 3. Ready-mix concrete manufacturer.



4. Cast-in-Place concrete subcontractor.
5. Polished concrete finishing subcontractor.

- B. Review mix design, cold-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

## 1.7 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
  1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1).

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

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

### 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

### 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture

bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

## 2.4 CONCRETE MATERIALS

- A. Cementitious Materials:
  - 1. Portland Cement: ASTM C 150/C 150M, Type I
  - 2. Fly Ash: ASTM C 618, Class F or C.
  - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) foundations; 3/4 inch (19 mm) nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- E. Water: ASTM C 94/C 94M.

## 2.5 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

## 2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

## 2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

## 2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

## 2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Normal-Weight Concrete:
  - 1. Minimum Compressive Strength: As indicated on the drawings at 28 days.
  - 2. Maximum W/C Ratio: As indicated on the drawings.
  - 3. Slump Limit: As indicated on the drawings. Limit indicated for slump prior to adding high-range water-reducing admixture or plasticizing admixture.
  - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for **1-inch** nominal maximum aggregate size.

## 2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## 2.13 CONCRETE FINISHING

- A. Product: Subject to compliance with requirements provide water-based sealer from Curecrete Distribution, Inc.
  1. Contact: 1203 W. Spring Creek Place, Springville, UT 84663-0551; Telephone: (800) 998-5664, (801) 489-5663; Fax: (801) 489-3307; Email: info@ashfordformula.com; Website: www.ashfordformula.com.
- B. Cure-Seal-Hardener: Ashford Formula, a water-based, chemically reactive penetrating sealer and hardener that densifies concrete to seal against water molecules, but allows air and water vapor to pass, so that concrete can achieve full compressive strength for minimized surface crazing and elimination of dusting.
  1. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.
  2. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
  3. Hardening: As follows when tested in accordance with ASTM C39.
    - a. After 7 Days: An increase of at least 40% over untreated samples.
    - b. After 28 Days: An increase of at least 38% over untreated samples.
  4. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
  5. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
  6. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Chamfer exterior corners and edges of permanently exposed concrete.

### 3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.3 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

### 3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.
  - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

### 3.6 WATERSTOP INSTALLATION

- A. Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.10 CONCRETE FINISHING APPLICATION

- A. New Concrete (Sealed): In areas indicated for exposed sealed concrete floor, finish as follows:

1. Apply cure-seal hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.
  - a. Spray on at rate of 200 ft<sup>2</sup>/gal (5 m<sup>2</sup>/L).
  - b. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry or become slippery. If slipperiness occurs before the 30 minute time period has elapsed, apply additional cure-seal-hardener, as needed, to keep the entire surface in a non-slippery state for the first 15 minutes; for the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
  - c. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
  - d. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
  - e. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
  - f. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.
- B. New Concrete (Polished): Refer to Section 033543 "Polished Concrete Finishing" for requirements on finishing areas indicated to receive polished concrete finish.
- C. Protect installed floors for at least 3 months until chemical reaction process is complete.
  1. Do not allow traffic on floors for 3 hours after application.
  2. Do not allow parking of vehicles on concrete slab.
  3. If vehicles must be temporarily parked on slab, place drop cloths under vehicles during entire time parked.
  4. Do not allow pipe cutting using pipe cutting machinery on concrete slab.
  5. Do not allow temporary placement and storage of steel members on concrete slabs.
  6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
  7. Clean floor regularly in accordance with manufacturer's recommendations.

### 3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m 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.

### 3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000



## SECTION 033543 - POLISHED CONCRETE FINISHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes polished concrete finishing.
- B. Related Requirements:
  - 1. Section 033000 "Cast-In-Place Concrete".

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Submit polished concrete finishes manufacturer's specifications and test data.
  - 2. Submit polished concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.
  - 3. Submit polished concrete finishes manufacturer's recommended installation procedures; which when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
  - 4. Submit polished concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include location of all joints, including construction joints.
- C. Samples: For each type of product requiring color selection.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Use an experienced installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
  - 2. The special concrete finish manufacturer shall certify applicator.
  - 3. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section.
- B. Manufacturer's Certification:
  - 1. Provide letter of certification from concrete finish manufacturer stating that installer is certified applicator of special concrete finishes and is familiar with proper procedures and installation requirements required by the manufacturer.
- C. Field Sample Panels: After approval of samples, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 50 square feet minimum, to demonstrate the expected range of finish, color, and appearance variations.
  - 1. Locate panels as indicated or, if not indicated, as directed by Architect.
  - 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Demolish and remove field sample panels when directed.
  - 4. Approved mock-ups may become part of the completed work if undisturbed at time of substantial completion.
- D. Protection
  - 1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.

- a. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
- b. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
- c. No pipe cutting machine will be used on the inside floor slab.
- d. Steel will not be placed on interior slab to avoid rust staining.
- e. Acids and acidic detergents will not come into contact with slab.
- f. All trades informed that the slab must be protected at all times.

#### 1.4 PROJECT CONDITIONS

- A. Environmental limitations:
  1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
    - a. Concrete Floor Flatness rating: 40 minimum.
    - b. Concrete Floor Levelness rating: 30 minimum.
    - c. Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of Retro Plate can begin.
- B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

### PART 2 - PRODUCTS

#### 2.1 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
    - a. Retro-Plate 99, manufactured by Advanced Floor Products, Inc., P.O. Box 50533, Provo, Utah 84605, 801-812-3420.
      - 1) Performance Criteria:
        - a) Abrasion Resistance: ASTM C779 - Up to 400% increase in abrasion resistance.
        - b) Impact Strength: ASTM C805 - Up to 21% increase impact strength.
        - c) Ultra Violet Light and Water Spray: ASTM G23-81 - No adverse effect to ultra violet and water spray.
        - d) Reflectivity: Up to 30% increase in reflectivity.
    - b. Architect approved equal.

#### 2.2 RELATED MATERIALS

- A. Neutralizing Agent:
  1. Tri-sodium Phosphate
- B. Water:
  1. Potable
- C. Joint Filler:
  1. CreteFill Pro 65, manufactured by Advanced Floor Products, Inc., P.O. Box 50533, Provo, Utah 84605, 801-812-3420.
    - a. Color: to match concrete as approved by architect.

### PART 3 - EXECUTION

#### 3.1 SURFACE CONDITIONS:

- A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify that base slab meets finish and surface profile requirements in Division 3 Section "Cast-In-Place Concrete," and Project Conditions above.
- C. Prior to application, verify that floor surfaces are free of construction latents.

#### 3.2 APPLICATION

- A. Start any of the floor finish applications in presence of manufacturer's technical representative.
- B. Sealing, Hardening and Polishing of Concrete Surface
  - 1. Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
  - 2. Application is to take place at least 10 days prior to racking and other in-store accessory installation, thus providing a complete, uninhibited concrete slab for application
  - 3. Only a certified applicator shall apply Liquid Floor Treatments. Applicable procedures must be followed as recommended by the product manufacturer and as required to match approved test sample.
  - 4. Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
  - 5. Apply joint filler per manufactures written instructions. Overfill joint to ensure complete fill and shave off excess material flush with concrete floor surface to achieve a smooth, uniform surface free of voids and gaps.

#### 3.3 POLISHING

- A. Polish: Level 3; Low sheen, 800 grit.
- B. Aggregate Exposure: Class D; Large Aggregate
- C. Apply polished concrete finish system to cured and prepared slabs.
  - 1. Machine grind floor surfaces to receive polished finishes level and smooth.
  - 2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
  - 3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
  - 4. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
  - 5. Control and dispose of waste products produced by grinding and polishing operations.
  - 6. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 04 0110 - MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cleaning the following:
  - 1. Stone and Brick masonry surfaces.

1.2 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)
- B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)
- C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Cleaning: Clean an entire area of one sill limestone piece.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  - 2. Along with cleaning all areas of the new masonry installations and where specific staining is noted to be cleaned, contractor shall clean all areas of existing masonry below and adjacent to the work area that may be affected by run-off or overspray at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.
- E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, eith pH between 6 and 9, that contains detergents and chelating agents and is specifically formulated for cleaning masonry surfaces.
1. Products:
- |    |                              |                                |
|----|------------------------------|--------------------------------|
| a. | <u>Price Research, Ltd.:</u> | Price Marble Cleaner-Gel       |
| b. | <u>PROSOCO, Inc.:</u>        | Sure-Klean 942 Masonry Cleaner |
| c. | Approved Equal               |                                |
- F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
1. Products:
- |    |                                    |   |
|----|------------------------------------|---|
| a. | <u>Dominion Restoration, Inc.:</u> | Bio-Cleanse                                 |
| b. | <u>Dumond Chemicals, Inc.:</u>     | Safe 'n Easy Architectural Cleaner/Restorer |
| c. | <u>Price Research, Ltd.:</u>       | Price Non-Acidic Masonry Cleaner            |
| d. | <u>PROSOCO, Inc.:</u>              | Enviro-Klean Restoration Cleaner            |
| e. | Approved Equal.                    |   |

## 2.2 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

### 3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
  - a. Equip units with pressure gages.
  - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
  - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
  - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
- F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
  1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

### 3.3 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, caulking, asphalt, and tar.
  1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.

### 3.4 CLEANING MASONRY

- A. Detergent Cleaning:
  1. Wet surface with hot water applied by low-pressure spray.

2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
  3. Rinse with hot water applied by low-pressure spray to remove detergent solution and soil.
  4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- B. Mold, Mildew, and Algae Removal:
1. Wet surface with hot water applied by low-pressure spray.
  2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
  3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
  4. Rinse with hot water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- C. Nonacidic Chemical Cleaning:
1. Wet surface with cold water applied by low-pressure spray.
  2. Apply cleaner to surface in two applications by brush or low-pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
  4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

END OF SECTION 040110

SECTION 04 0120- MASONRY REPAIR

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. Removing and reinstalling stone coping
  - 2. Repairing brick masonry, including replacing units and partial wall reconstruction.
  - 3. Injected epoxy for stone cracks and anchoring of dowel pins.
  - 4. Removing abandoned anchors.
  - 5. Painting steel uncovered during the work.

1.3 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)
- B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5500 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
  - 1. Required attendance: Architect, Owner, Contractor's Superintendent, Masonry and Roofing Contractor Foremen, Testing and Inspection Company Representative.
  - 2. Review scheduling, coordination, methods and procedures related to parapet repair.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include recommendations for product application and use.
- B. Samples, for each product indicated:
  - 1. Colored Mortar: Submit samples of mortar that will be left exposed.
    - a. Have each sample contain a mix of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
  - 2. Patching Compound: Submit 3 (three) sets of patching compound samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
  - 3. Brick Tie and Flashing: Submit one (1) sample each of all various brick ties and flashing pieces.
  - 4. Samples of other exposed accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For brick masonry repair specialist including field supervisors and workers.



1.7 QUALITY ASSURANCE

- A. Restoration Specialist Qualifications: Engage an experienced masonry restoration firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience.
  - 1. Field Supervision: Masonry restoration specialist firm shall maintain experienced full-time supervisors on Project site during times that masonry restoration work is in progress.
  - 2. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of types indicated.
- B. Construction Testing and Inspection: Owner will engage a qualified independent testing agency to perform construction testing and inspection as follows:
  - 1. Inspector will be on site periodically during the parapet reconstruction period. Contractor to cooperate with inspector and allow use of lift devices and scaffolding as needed to perform inspections.
  - 2. Inspector will perform up to 4 (four) random destructive inspections of parapet masonry construction to observe adherence to specifications including; through-wall flashing installation, coping dowel anchor installation, sealing of flashing lap joints, sealing of dowel penetrations, and coping joint sealant.
  - 3. Contractor to re-construct the inspected construction.
- C. Architect's Project Representatives: Architect will assign Project Representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.
- D. Notify inspectors and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.
- E. Source Limitations: Obtain each type of material for masonry restoration (cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.
- F. Mockups: Prepare mockups of masonry parapet repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.
  - 1. Parapet Mockup: Prepare a section of re-constructed parapet one - to - two coping sections long (approximately 4 to 6 linear feet).
    - a. Include at least one through-wall flashing joint, counter-flashing joint, wall flashing vertical seam and one end dam.
    - b. Leave stone coping off a portion to expose the through wall flashing joint and at least one dowel penetration for review.
    - c. Mockup will be prepared and reviewed in stages with Architect and Owner's Representative present. Proposed stages may consist of:
      - 1) Upon Demolition of existing
      - 2) When new masonry is install but before flashing
      - 3) Flashing and dowel pin installation
      - 4) Stone coping reinstalled and joints sealed.
  - 2. Brick Repair / Replacement Mockup: 4 (four) square feet minimum.
  - 3. Tuck-Pointing Mockup: 4 (four) square feet minimum.

4. Provide 4 minimum masonry cleaning mockups to determine best cleaning agent.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.
- B. Store cementitious materials and lime on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store sand where grading and other required characteristics can be maintained and contamination avoided.
- D. Handle masonry units to prevent overstressing, chipping, defacement, and other damage.

#### 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits, General: Repair masonry units only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work.
- C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:
  1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair and pointing materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
  2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after repair and pointing.
- D. Hot-Weather Requirements: Protect masonry repairs and pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.
- B. It is the intent to match existing brick color, texture, shading variations and outward appearance as closely as possible. Subject to compliance with performance requirements, contractors may propose alternative brick from their available sources. The existing brick size is standard. Contractors may at their option utilize modular brick for areas not exposed to view and for creating header courses. All exposed stretchers are to be standard size to match existing.

## 2.2 MASONRY MATERIALS

- A. Face Brick:
  - 1. Basis of design brick: Subject to compliance with requirements, brick approved for use on this project include, but are not limited to the following:
    - a. Indicated in section 042000 Unit Masonry.
    - b. Salvaged brick to be reinstalled.

## 2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Federal Specification SS-C-1292, Type I, white or gray, or both where required for color matching of mortar.
  - 1. Use ASTM C 91 non-staining cement for stone setting.
- B. Hydrated Lime: ASTM C 207 (hydrated), Type S or ASTM C5 (quicklime).
- C. Mortar Sand: ASTM C 144, unless otherwise indicated.
  - 1. For pointing mortar, provide sand with rounded edges.
  - 2. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
- D. Water: Potable.

## 2.4 MANUFACTURED REPAIR MATERIALS

- A. Injected Epoxy: For stone crack repair and anchorage or dowel pins.
  - 1. Crack and Injection Ports: 100% solids, moisture-tolerant, high modulus, high strength, structural. smooth paste epoxy, conforming to ASTM C-881.
    - a. Product: Sika Corporation; Sikadur 33.
  - 2. Pressure Injection Epoxy: Two component, 100% solids, moisture tolerant, low-viscosity, high-strength, multi-purpose epoxy resin adhesive.
    - a. Product: Sika Corporation; Sikadur 35, Hi-Mod LV.
- B. Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
  - 1. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than masonry units being repaired, and develops high bond strength to all types of masonry.
  - 2. Patching of brick is only authorized for minor anchor holes in a sound brick. Intent for damaged brick is total unit replacement. Patching Compound for brick to be Jahn M-100 terra cotta and brick repair mortar.
  - 3. Patching Compound for stone to be Jahn M70 stone repair mortar.

## 2.5 FLASHING MATERIALS

- A. Through-Wall Flashing and Reglet: Fabricate to comply with the following requirements:
  - 1. Stainless Steel: ASTM A 240, Type 304 stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4mm) thick.
  - 2. Fabricate with drip ½ inch out from exterior face of the wall, having a hemmed outer edge bent down 30 degrees, and a reglet on interior face of wall or receptor for counterflashing provided by roofing installer.
  - 3. Punch for dowels required for coping dowel anchors. Raised dimple in the flashing shall face upward.
  - 4. Fabrications shall comply with SMACNA and NRCA design standards.

## 2.6 MORTAR MIXES

- A. General: Contractor is responsible for testing existing mortar to match new mortar to the existing mortar's compressive strength and consistency. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands, if necessary, to achieve suitable match.
- B. Mortar Mixes: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Mix materials in a clean, mechanical batch mixer.
  - 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.
- C. Do not use admixtures of any kind in mortar, unless otherwise indicated.
- D. Pointing Mortar for Brick (Type N): 1 part portland cement, 1 part lime, and 6 parts sand (Not less than 2-1/4 and not more than 3 times the sum of the volumes of cement and lime used.).
  - 1. Use only as required for tuck pointing any existing Type N or S mortar used in laying brick having absorption rates greater than 25 gm./min./ 30 sq. in.
- E. Rebuilding (Setting) Mortar (Type N): 1 part portland cement, 1 part lime, and 6 parts sand Same as pointing mortar.

## 2.7 ACCESSORY MATERIALS

- A. Lap Sealant and Silicone sealant are specified under Division 7.
- B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.
- C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating formulated for use on hand-tool cleaned previously rusted steel surfaces.
- D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
  - 1. Previous effectiveness in performing the work involved.
  - 2. Minimal possibility of damaging exposed surfaces.
  - 3. Consistency of each application.
  - 4. Uniformity of the resulting overall appearance.
  - 5. Do not use products or tools that could leave residue on surfaces.

## 2.8 CLEANING MATERIALS

- A. Refer to Specifications Section 040110 "Masonry Cleaning".

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

1. Cover adjacent surfaces with materials that resist chemical cleaners used unless chemical cleaners will not damage surfaces. Use materials that contain only waterproof, UV-resistant adhesives.
- B. Prevent mortar from staining face of surrounding masonry and other surfaces.
  1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
  2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
  3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
- C. Provide temporary cover and rain drainage if required during work to direct water off exposed wall surfaces and away from building.

### 3.2 MASONRY REPAIR, GENERAL

- A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 50 feet (15 m) away by Architect.
- B. Verify testing and acceptance of steel welding repairs and pan flashings prior to covering with new masonry.

### 3.3 STONE COPING REMOVAL, PREPARATION AND STORAGE

- A. Remove existing stone coping, prep and save for reinstallation:
  1. Carefully remove existing stone copings from wall, avoiding damaging units or adjacent construction. Do not exceed loading capacities of existing roofing and structures.
  2. Tag each piece and notate on a plan or schedule it's location for reinstallation.
  3. Manually scrape or remove residual mortar, flashing, etc. using hand tools, brushes and water. Remove sealants by cutting close to stone with utility knife and cleaning with non-staining solvents.
  4. Clean stone coping using non-acidic cleaner.
  5. Store stone coping on pallets or other raised surface and protected from weather until ready for reinstallation.

### 3.4 ACCESSORY REMOVAL

- A. Remove anchors, and other extraneous items in the area of work.
  1. Remove items carefully to avoid spalling or cracking masonry.
  2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry.
  3. Patch holes where extraneous items were removed and are not intended to be reinstalled, unless directed to remove and replace entire masonry unit.

### 3.5 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
  1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels as required.

- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- F. Replace removed damaged brick with new brick matching existing brick.
- G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
  - 1. Maintain joint width for replacement units to match existing joints.
  - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- H. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
  - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
  - 2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- I. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
  - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

### 3.6 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
  - 1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning, as applicable to comply with paint manufacturer's recommended preparation.
  - 2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

### 3.7 SETTING STONE COPING

- A. Stone coping will be reinstalled in mortar bed in same location as existing, over new stainless steel through - wall flashing.
  - 1. Anchor horizontal coping using new stainless steel dowel anchors in lieu of thin metal tab anchors originally used.
  - 2. On sloping pieces, stainless steel split-tailed stone anchors may be used in lieu of dowels. Anchors to be MasonPro AST-Series, or approved equal.
- B. Drill stone coping for new dowel anchors. Dowel holes should be over-bored 1/4".
- C. Install dowels into rebuilt masonry parapet, accurately coordinated with penetrations in through-wall flashing.

- D. Install through - wall flashing with dimples formed from punching dowel penetrations facing upward, to form a water dam at the dowel. Install continuous bead of butyl sealant around the dowel penetration above and below the flashing and allow to cure. Lap through-wall flashing six-inches at joints and provide three 1/4-inch beads of butyl lap sealant continuous from edge of metal to edge of metal.
- E. Set stone in a full bed of mortar with head joints filled unless otherwise indicated. Provide sealant in the dowel holes in lieu of mortar to allow for thermal movement.
- F. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when mortar is thumbprint hard.
- G. Rake out mortar from head joints and other sealant-pointed joints to depths required for sealant and sealant backing but not less than 1 inch. Rake joints to uniform depths with square bottoms and clean sides.
- H. Provide backer rod and silicone sealant in head joints and bed joints.

### 3.8 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m). For external corners, corners and jambs and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m).
- B. Variation from Level: For, parapets, horizontal bands, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m).
- C. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).
- D. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less.
- E. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

### 3.9 MASONRY UNIT PATCHING

- A. Patch the following masonry units unless another type of repair or replacement is indicated:
  - 1. Units indicated to be patched.
  - 2. Units with holes less than 3/8 - inch diameter.
  - 3. Units in the area of work with holes greater than 3/8-inch diameter, chipped edges or corners or units with any areas of deep deterioration (or cracks) are to be replaced.
- B. Remove and replace existing patches if found loose, cracked or deteriorated.
- C. Prepare patching in accordance with patching material manufacturer's instructions.

### 3.10 ANCHORING STONE

- A. Anchor stone to existing masonry or steel structure as shown and indicates in the drawings.

### 3.11 STONE AND CONCRETE CRACK REPAIR

- A. Prepare for repair by scraping loose material and cleaning surfaces for repair work.
- B. Place Sikadur 33 neat mixed material over cracks to be pressure-injected and around each injection port. Allow sufficient time to set before pressure injection.
- C. For gravity feed cracks, pour Sikadur 35 Hi-Mod LV into vee-notched crack. Continue placement until completely filled.

- D. For pressure-injected cracks, use automated injection equipment or manual method appropriate injection ports based on system used. Seal ports and cracks with Sikadur 33. When epoxy adhesive seal has cured, inject Sikadur 33 Hi-Mod LV with steady pressure.
- E. Clean stone surface of epoxy residue before material hardens.

### 3.12 ADJUSTING AND PROGRESS CLEANING

- A. Adjust stone work to comply with installation tolerances and approved mockups.
- B. Remove and reinstall any stone work that does not match approved mockup. Damaged stone may be repaired if Architect approves methods and results.
- C. In-Progress Cleaning: Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

### 3.13 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
  - 1. Do not use metal scrapers or brushes.
  - 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from drainage system. Rinse off roof and remove masking materials. Leave no residues that could trap dirt.

### 3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.
- B. Masonry Waste: All masonry waste is to be recycled.

END OF SECTION 040120



SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

1. Concrete block.
2. Clay facing brick.
3. Mortar and grout.
4. Reinforcement and anchorage.
5. Flashings.
6. Cavity wall insulation.
7. Lintels.
8. Accessories.
9. Products installed under this section:
  - a. Precast architectural concrete units set in masonry; furnished by Section 03 4500 - Precast Architectural Concrete.
  - b. Cast stone units set in masonry; furnished by Section 04 7200 - Cast Stone Masonry.
  - c. Loose steel lintels in unit masonry; furnished by Section 05 5000 - Metal Fabrications.
  - d. Manufactured reglets embedded in unit masonry; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.
10. Products furnished under this section:
  - a. Dovetail anchor slots for connecting masonry to cast-in-place concrete; installed by Section 03 3000 - Cast-in-Place Concrete.
  - b. Structural steel anchor sections for connecting masonry to structural steel; installed by Section 05 1200 - Structural Steel Framing.

1.2 REFERENCE STANDARDS

- A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.
- B. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- C. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2018.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2019.
- E. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2021.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
- I. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- J. ASTM C150/C150M - Standard Specification for Portland Cement 2021.
- K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- L. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2021.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.

- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- O. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- P. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2019.
- Q. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- R. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar 1992a (Reapproved 2014).
- S. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2021.
- T. ASTM C 1329 - Standard Specification for Mortar Cement - 2016.
- U. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
- V. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017.
- W. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2020.
- X. BIA Technical Notes No. 7 - Water Penetration Resistance - Design and Detailing 2017.
- Y. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
- Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

### 1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for the following:
  - 1. Masonry Units:
    - a. Include data on material properties.
    - b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Brick units:
    - a. For exposed brick, include test report for efflorescence according to ASTM C 67.
    - b. Include size-variation data verifying that the actual range of sizes falls within specified tolerances.
  - 3. Cementitious materials. Include name of manufacturer, brand name and type.
  - 4. Mortar admixtures.
  - 5. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
  - 6. Grout mixes. Include description of type and proportion of ingredients.
  - 7. Sound Isolating anchors.
  - 8. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
  2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
    - a. Comply with ACI 315.
  3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.
  - D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
    1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C 91M for air content.
    2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.
  - E. Samples: Submit 3 samples of standard block, decorative block, facing brick, ceramic glazed facing brick, and ceramic glazed structural clay facing tile units to illustrate color, texture, and extremes of color range.
  - F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
  - G. Test Reports:
    1. Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
    2. Masonry Veneer Anchors: At wall cavities greater than 4-1/2 inches, provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements; wall cavity depth includes airspace and cavity wall insulation thickness.
  - H. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
  - I. Manufacturer's Qualification Statement.
  - J. Installer's Qualification Statement.
  - K. Cold-Weather and Hot-Weather Procedures: Detail description of methods, material, and equipment to be used to comply with requirements.
- 1.5 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
  - B. Fire Rated Assemblies: Comply with applicable codes and UL Assembly Numbers indicated.
  - C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
  - D. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- 1.6 MOCK-UP

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
- B. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up).

- C. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
- D. Locate where directed.
- E. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
- F. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
- G. 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.
  - 1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
  - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in a enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- F. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each days's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three 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 spreading coverings 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.
- 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/ACI 530.1/ASCE 6.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
  2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS (CMU-1, CMU-2)

- C. Concrete Block: Comply with referenced standards and as follows:
  1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
  2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
  3. Exposed Outside Block Corners: Provide bullnose, radiused, corners unless otherwise indicated on Drawings.
    - a. Field-ground radiused corners are not permitted.
    - b. Stop bullnose at bulkhead/soffits.
    - c. Provide square corners at door frame even with block and bullnose where door frame is set back from corner.
  4. Load-Bearing and Non-Loadbearing Units: ASTM C90, normal weight.
    - a. Standard Units:
      - 2) Exposed Faces: Manufacturer's standard color and texture as approved by Architect per ASTM C90.
      - 3) Manufacturers:
        - (a) Consumers Concrete Corp.: [www.consumersconcrete.com](http://www.consumersconcrete.com).
        - (b) Echelon by Oldcastle: [www.echelonmasonry.com](http://www.echelonmasonry.com).
        - (c) Fendt Builder's Supply, Inc.: [www.fendtproducts.com](http://www.fendtproducts.com).
        - (d) Grand Blanc Cement Products: [www.grandblancementproducts.com](http://www.grandblancementproducts.com).
        - (e) Michigan Certified Products, Inc.: [www.micertconcrete.com](http://www.micertconcrete.com).
        - (f) National Block Company: [www.nationalblock.com](http://www.nationalblock.com).
        - (g) Substitutions: See Section 012500 - Product Requirements.

5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
  - a. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
  - b. Performance of Units with Integral Water Repellent:
    - 2) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
      - (a) No water visible on back of wall above flashing at the end of 24 hours.
      - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
      - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
    - 3) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
    - 4) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    - 5) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
  - c. Limitations:
    - 2) Use only in combination with mortar containing integral water repellent admixture.
    - 3) Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
  - d. Products:
    - 2) BASF Corp.; MasterPel 240: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
    - 3) Euclid Chemical Company (The); an RPM company; Eucon Blocktite Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
    - 4) GCP Applied Technologies Inc.; Dry-Block Block Admixture: [www.gcpat.com](http://www.gcpat.com).
    - 5) Substitutions: See Section 012500 - Product Requirements.

## 2.3 BRICK UNITS (B-1, B-2)

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Manufacturers: Provide products from the manufacturer listed for each brick type.
  1. Brick Tech Architectural, Inc.: [www.interstatebrick.com](http://www.interstatebrick.com).
  2. Belden Brick Company
  3. Substitutions: Not permitted.
- C. Facing Brick:
  1. Special shapes: Provide molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
  2. B-1: Field Brick.
    - a. Manufacturer: Belden Brick Company

- 2) Substitutions: Not permitted.
  - b. ASTM C216, Type FBS, Grade SW.
  - c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
  - d. Color/Blend: 141-145 Vertical.
  - e. Texture: Vertical Cut.
3. B-2: Field Brick.
- a. Manufacturer: Belden
  - 2) Substitutions: Not permitted.
  - b. ASTM C216, Type FBS, Grade SW.
  - c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
  - d. Color/Blend: Modular 470-479 light A. Match Existing
  - e. Texture: Smooth.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Cement: ASTM C1329.
- C. Portland Cement: ASTM C150/C150M, Type I.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Mortar Aggregate: ASTM C144.
- F. Grout Aggregate: ASTM C404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): 94X.
  - 2. Manufacturers:
    - a. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - b. Lambert Corporation: [www.lambertusa.com](http://www.lambertusa.com).
    - c. Solomon Colors: [www.solomoncolors.com/sle](http://www.solomoncolors.com/sle).
    - d. Substitutions: See Section 012500 - Product Requirements.
- H. Water: Clean and potable.
- I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
  - 1. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
  - 2. Limitations:
    - a. Use only in combination with masonry units manufactured with integral water repellent admixture.
    - b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
  - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.
  - 4. Products:
    - a. BASF Corp.; MasterPel 210MA: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
    - b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
    - c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: [www.gcpat.com](http://www.gcpat.com).
    - d. Substitutions: See Section 012500 - Product Requirements.

- J. Packaged Dry Material for Mortar for Unit Masonry:
  - 1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
    - a. Mortar Types: As indicated.
    - b. Color(s): As selected by Architect from manufacturer's full range.
    - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
  - 2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
    - a. Manufacturers:
      - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
      - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
      - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
      - 4) Substitutions: See Section 012500 - Product Requirements.
  - 3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
    - a. Manufacturers:
      - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
      - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
      - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
      - 4) Substitutions: See Section 012500 - Product Requirements.
- K. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
  - 1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
  - 2. Manufacturers:
    - a. Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
    - b. The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
    - c. SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
    - d. Substitutions: See Section 012500 - Product Requirements.

## 2.5 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
  - 1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
    - a. Fero Corp.; [www.ferocorp.com](http://www.ferocorp.com).
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. Substitutions: See Section 012500 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; Uncoated.
- C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.



1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): Spyra-Lox Rebar Lap- Joint Tie.
- E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 120 Truss-Mesh or 220 Ladder-Mesh.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 344 Rigid Partition Anchor.
- H. Partition Top Anchors: 0.1875 inch thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube; hot dip galvanized to ASTM A153/A153M Class B.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): PTA-420-HS and PTA Tubes.
- I. Dovetail Anchor Slots for Connecting to Concrete: 2-piece anchors that permit differential movement between masonry and concrete frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
  1. Concrete frame: Dovetail anchors of bent steel, nominal 1 inch width by 1 inch deep by 0.03 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
    - a. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.
- J. Adjustable Anchors for Connecting to Structural Steel Framing: 2-piece anchors that permit differential movement between masonry and steel frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
  1. Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
  2. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 359/359FP anchors with 301W or VBT ties.
- K. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  1. For cold-formed metal framing and sheathing back-up.

2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
3. Wire ties: Rectangular shape, 0.1875 inch thick.
4. Vertical adjustment: Not less than 2 inches.
5. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): HB-213 anchors with 2X-HOOK.
- L. Sound Isolating Anchors.
  1. Provide as indicated on the Drawings.
    - a. Basis of Design Product: Provide PSB-M isolators as manufactured by Kinetics. Texture Wire cut or as follows:
      - 1) Mason Industries AB-716.

## 2.6 FLASHINGS

- A. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
  1. Type 304 stainless steel.
    - a. Thickness: 2 mils, minimum.
  2. Basis-of-Design Product: Provide York Manufacturing, Inc.; York 304: [www.yorkmfg.com](http://www.yorkmfg.com), or one of the following products:
    - a. Hohmann & Barnard, Inc.; Mighty-Flash SA: [www.h-b.com](http://www.h-b.com).
    - b. Wire-Bond; Bond-N-Flash SA: [www.wirebond.com](http://www.wirebond.com).
    - c. Substitutions: See Section 012500 - Product Requirements.
  3. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
    - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.
  4. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
    - a. Pre-formed smooth drip plates with hemmed edges.
    - b. Manufacturer shall be the same as stainless steel/polymer fabric flashing manufacturer.
  5. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
    - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.

## 2.7 CAVITY WALL INSULATION

- A. Extruded Polystyrene Board, ASTM C 578-, Type IV, 25 psi minimum compressive strength, unfaced, R5.6 per inch. Provide thickness as indicated on the drawings.
  1. Basis-of-Design: Styrofoam Cavitymate Ultra Extruded Polystyrene Foam Insulation as manufactured by The Dow Chemical Company.
  2. Equal products as manufactured by one of the following companies are also acceptable:
    - a. DiversiFoam Products.
    - b. Owens Corning.
- B. Adhesive and Joint Filler: Type as recommended and approved by the insulation manufacturer.

## 2.8 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.

1. Manufacturers:
  - a. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
  - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
  - c. Substitutions: See Section 012500 - Product Requirements.
- B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
  1. Manufacturers:
    - a. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
    - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
    - c. Substitutions: See Section 012500 - Product Requirements.
- C. Cavity Mortar Control/Drainage Material: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
    - b. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); Mortar Trap or a comparable product by one of the following:
      - 1) Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com).
      - 2) Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
      - 3) Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com).
      - 4) Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
      - 5) Substitutions: See Section 012500 - Product Requirements.
- D. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- E. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
  1. Manufacturers:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com)
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. York Manufacturing, Inc.; [www.yorkmfg.com](http://www.yorkmfg.com)
    - f. Substitutions: See Section 012500 - Product Requirements.
- F. Weep Inserts and Cavity Vents:
  1. Type: Plastic cellular/honeycomb design.
  2. Color(s): As selected by Architect from manufacturer's full range.
  3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); QV Quadro- Vent or a comparable product by one of the following:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com).
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. Substitutions: See Section 012500 - Product Requirements.
- G. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
  1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); MGS or a comparable product by one of the following:
    - a. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - b. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - c. Substitutions: See Section 012500 - Product Requirements.
- H. Masonry Cleaners:

1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - a. Basis-of-Design Products: Provide PROSOCO, Inc.; [www.prosoco.com](http://www.prosoco.com): Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
    - 1) Diedrich Technologies, Inc.; [www.diedrichtechnologies.com](http://www.diedrichtechnologies.com).
    - 2) Substitutions: See Section 012500 - Product Requirements.

## 2.9 LINTELS

- A. Masonry Lintels: Masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and weight classification; reinforcing bars as indicated, and filled with grout.
- B. Loose Steel Lintels: Refer to Section 05 5000 - Metal Fabrications.

## 2.10 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  1. Masonry below grade and in contact with earth: Type M.
  2. Exterior, loadbearing masonry: Type S.
  3. Exterior, non-loadbearing masonry: Type N.
  4. Interior, loadbearing masonry: Type N.
  5. Interior, non-loadbearing masonry: Type N.
  6. Precast concrete units: Same Type as wall masonry in which unit is set.
  7. Limestone units: Same Type as wall masonry in which unit is set.
  8. Pointing Mortar: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
  1. Brick Mortar Color: 85X Dark Chocolate.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
  1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that foundations are within tolerances specified.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- E. Verify that reinforcing dowels are properly placed.

### 3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

### 3 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying 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. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

#### 3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Existing Masonry: Match coursing and bonding of existing masonry unless otherwise indicated.
- D. Concrete Masonry Units: Unless otherwise indicated:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
  - 4. Mortar Joint Thickness: 3/8 inch.
- E. Brick Units: Unless otherwise indicated:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.
  - 4. Mortar Joint Thickness: 3/8 inch.

#### 3.3 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- 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. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high-pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
- G. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar, and replace.

- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- J. Cut mortar joints flush where wall tile is scheduled, or resilient base is scheduled.
- K. Isolate the top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
- L. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.
- M. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Allow cleaned surfaces to dry before setting.
  - 3. Wet joint surfaces thoroughly before applying mortar.
  - 4. Rake out mortar joints for pointing with sealant.

#### 3.4 WEEPS INSERTS/CAVITY VENTS

- A. Install weep inserts in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

#### 3.5 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.
- C. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

#### 3.6 HORIZONTAL JOINT REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in the first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry to Structural Steel and Concrete:
  - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under

specific wall type, space anchors at maximum of 24 inches horizontally and 24 inches vertically.

- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8-inch mortar cover to the outside face of the anchor.

### 3.7 MASONRY VENEER REINFORCEMENT AND ANCHORAGE

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Embed ties and anchors in mortar joint and extend into masonry veneer unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

### 3.8 MASONRY FLASHINGS

- A. General:
  - 1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
  - 4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
    - a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
  - 5. Terminate flashing up 8 inches minimum on vertical surface of backing:
    - a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicated.
    - b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
  - 6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Flexible Fabric Flashing:
  - 1. Use factory-fabricated drip plates, corners and end dams.
  - 2. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
  - 3. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
  - 4. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

### 3.9 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
  - 1. Unless otherwise indicated, reinforce as follows:

- a. Openings to 48 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
    - b. Openings from 48 inches to 80 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
    - c. Openings over 80 inches: Reinforce openings as detailed.
  2. Do not splice reinforcing bars.
  3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
  4. Place and consolidate grout fill without displacing reinforcing.
  5. Allow masonry lintels to attain specified strength before removing temporary supports.
  - C. Where the Drawings do not indicate otherwise, provide reinforced unit masonry lintels at all openings and penetrations wider than 12 inches in brick and 24 inches in CMU.
  - D. Maintain minimum 8 inch bearing on each side of opening unless otherwise indicated.
- 3.10 BOND BEAMS

- A. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.
  - B. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web unless otherwise indicated.
  - C. Lap reinforcing bar splices minimum 24 bar diameters, unless otherwise indicated.
  - D. Place and consolidate grout fill without displacing reinforcing.
- 3.11 VERTICAL MASONRY REINFORCEMENT

- A. Reinforcement: Size and place vertical masonry reinforcement to comply with TMS 402/602 requirements and as indicated on Drawings.
  - B. Place and consolidate grout fill without displacing reinforcing.
- 3.12 GROUTING

- A. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
- B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
  1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
- C. Low-Lift Grouting:
  1. Limit height of pours to 12 inches.
  2. Limit height of masonry to 16 inches above each pour.
  3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
  4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- D. High-Lift Grouting:
  1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
  2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
  3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
  4. Place grout for spanning elements in single, continuous pour.



### 3.13 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.
- C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

### 3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
  - 1. Refer to Section 07 9200 - Joint Sealants for sealant installation.
- C. Control Joints to be spaced at no greater than the least of 1.5 times the height of the masonry wall, 24'-0" max, or as shown on design documents. Control Joints shall be provided within 12'-0" or .75 times the height of the masonry wall of the corners of the wall construction.

### 3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, glazed frames, anchor bolts, plates, and reglets and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
  - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

### 3.16 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
    - a. Plus or minus 1/2 inch.
  - 2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
    - a. Minus 1/4 inch.
    - b. Plus 1/2 inch.
  - 3. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
  - 4. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
  - 5. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
  - 6. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
  - 7. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
  - 8. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
  - 9. Lines and Levels:
    - a. Maximum variation from level:
      - 1) Includes, but is not limited to, the following:
        - (a) Lintels.
        - (b) Sills.
        - (c) Parapets.

- (d) Reveals.
      - (e) Other conspicuous lines.
    - 2) Do not vary from level by more than:
      - (a) 1/4 inch in 20 feet.
      - (b) 1/2 inch in 40 feet or more.
    - b. Maximum variation from plumb:
      - 1) Includes, but is not limited to, the following:
        - (a) External corners.
        - (b) Control and expansion joints.
        - (c) Reveals.
        - (d) Other conspicuous lines.
      - 2) Do not vary from plumb by more than:
        - (a) 1/4 inch in 20 feet.
        - (b) 1/2 inch in 40 feet or more.
  - 10. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.
- 3.17 FIELD QUALITY CONTROL
- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- 3.18 CLEANING
- A. Protect surrounding elements and finishes from damage due to cleaning procedures.
  - B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
  - C. Remove excess mortar and mortar droppings.
  - D. Clean soiled surfaces with cleaning solution.
  - E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
    - 1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
      - a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.
  - F. Ground-Face CMU: Refer to Section 09 9100 - Painting for field applied sealer.

END OF SECTION

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

1. Concrete block.
2. Clay facing brick.
3. Mortar and grout.
4. Reinforcement and anchorage.
5. Flashings.
6. Cavity wall insulation.
7. Lintels.
8. Accessories.
9. Products installed under this section:
  - a. Precast architectural concrete units set in masonry; furnished by Section 03 4500 - Precast Architectural Concrete.
  - b. Cast stone units set in masonry; furnished by Section 04 7200 - Cast Stone Masonry.
  - c. Loose steel lintels in unit masonry; furnished by Section 05 5000 - Metal Fabrications.
  - d. Manufactured reglets embedded in unit masonry; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.
10. Products furnished under this section:
  - a. Dovetail anchor slots for connecting masonry to cast-in-place concrete; installed by Section 03 3000 - Cast-in-Place Concrete.
  - b. Structural steel anchor sections for connecting masonry to structural steel; installed by Section 05 1200 - Structural Steel Framing.

1.2 REFERENCE STANDARDS

- A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.
- B. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- C. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2018.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2019.
- E. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2021.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
- I. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- J. ASTM C150/C150M - Standard Specification for Portland Cement 2021.
- K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- L. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2021.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.

- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- O. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- P. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2019.
- Q. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- R. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar 1992a (Reapproved 2014).
- S. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2021.
- T. ASTM C 1329 - Standard Specification for Mortar Cement - 2016.
- U. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
- V. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017.
- W. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2020.
- X. BIA Technical Notes No. 7 - Water Penetration Resistance - Design and Detailing 2017.
- Y. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
- Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

### 1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for the following:
  - 1. Masonry Units:
    - a. Include data on material properties.
    - b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Brick units:
    - a. For exposed brick, include test report for efflorescence according to ASTM C 67.
    - b. Include size-variation data verifying that the actual range of sizes falls within specified tolerances.
  - 3. Cementitious materials. Include name of manufacturer, brand name and type.
  - 4. Mortar admixtures.
  - 5. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
  - 6. Grout mixes. Include description of type and proportion of ingredients.
  - 7. Sound Isolating anchors.
  - 8. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
  2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
    - a. Comply with ACI 315.
  3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.
  - D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
    1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C 91M for air content.
    2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.
  - E. Samples: Submit 3 samples of standard block, decorative block, facing brick, ceramic glazed facing brick, and ceramic glazed structural clay facing tile units to illustrate color, texture, and extremes of color range.
  - F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
  - G. Test Reports:
    1. Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
    2. Masonry Veneer Anchors: At wall cavities greater than 4-1/2 inches, provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements; wall cavity depth includes airspace and cavity wall insulation thickness.
  - H. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
  - I. Manufacturer's Qualification Statement.
  - J. Installer's Qualification Statement.
  - K. Cold-Weather and Hot-Weather Procedures: Detail description of methods, material, and equipment to be used to comply with requirements.
- 1.5 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
  - B. Fire Rated Assemblies: Comply with applicable codes and UL Assembly Numbers indicated.
  - C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
  - D. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.
- 1.6 MOCK-UP

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
- B. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up).

- C. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
- D. Locate where directed.
- E. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
- F. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
- G. 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.
  - 1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
  - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in a enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- F. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each days's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three 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 spreading coverings 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.
- 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/ACI 530.1/ASCE 6.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
  2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS (CMU-1, CMU-2)

- C. Concrete Block: Comply with referenced standards and as follows:
  1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
  2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
  3. Exposed Outside Block Corners: Provide bullnose, radiused, corners unless otherwise indicated on Drawings.
    - a. Field-ground radiused corners are not permitted.
    - b. Stop bullnose at bulkhead/soffits.
    - c. Provide square corners at door frame even with block and bullnose where door frame is set back from corner.
  4. Load-Bearing and Non-Loadbearing Units: ASTM C90, normal weight.
    - a. Standard Units:
      - 2) Exposed Faces: Manufacturer's standard color and texture as approved by Architect per ASTM C90.
      - 3) Manufacturers:
        - (a) Consumers Concrete Corp.: [www.consumersconcrete.com](http://www.consumersconcrete.com).
        - (b) Echelon by Oldcastle: [www.echelonmasonry.com](http://www.echelonmasonry.com).
        - (c) Fendt Builder's Supply, Inc.: [www.fendtproducts.com](http://www.fendtproducts.com).
        - (d) Grand Blanc Cement Products: [www.grandblancementproducts.com](http://www.grandblancementproducts.com).
        - (e) Michigan Certified Products, Inc.: [www.micertconcrete.com](http://www.micertconcrete.com).
        - (f) National Block Company: [www.nationalblock.com](http://www.nationalblock.com).
        - (g) Substitutions: See Section 012500 - Product Requirements.

5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
  - a. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
  - b. Performance of Units with Integral Water Repellent:
    - 2) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
      - (a) No water visible on back of wall above flashing at the end of 24 hours.
      - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
      - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
    - 3) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
    - 4) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    - 5) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
  - c. Limitations:
    - 2) Use only in combination with mortar containing integral water repellent admixture.
    - 3) Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
  - d. Products:
    - 2) BASF Corp.; MasterPel 240: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
    - 3) Euclid Chemical Company (The); an RPM company; Eucon Blocktite Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
    - 4) GCP Applied Technologies Inc.; Dry-Block Block Admixture: [www.gcpat.com](http://www.gcpat.com).
    - 5) Substitutions: See Section 012500 - Product Requirements.

## 2.3 BRICK UNITS (B-1, B-2)

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Manufacturers: Provide products from the manufacturer listed for each brick type.
  1. Brick Tech Architectural, Inc.: [www.interstatebrick.com](http://www.interstatebrick.com).
  2. Belden Brick Company
  3. Substitutions: Not permitted.
- C. Facing Brick:
  1. Special shapes: Provide molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
  2. B-1: Field Brick.
    - a. Manufacturer: Belden Brick Company



- 2) Substitutions: Not permitted.
- b. ASTM C216, Type FBS, Grade SW.
- c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
- d. Color/Blend: 141-145 Vertical.
- e. Texture: Vertical Cut.

3. B-2: Field Brick.

- a. Manufacturer: Brick Tech Architectural
- 2) Substitutions: Not permitted.
- b. ASTM C216, Type FBS, Grade SW.
- c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
- d. Color/Blend: Ochre Buff.
- e. Texture: Smooth.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Cement: ASTM C1329.
- C. Portland Cement: ASTM C150/C150M, Type I.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Mortar Aggregate: ASTM C144.
- F. Grout Aggregate: ASTM C404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): 94X.
  - 2. Manufacturers:
    - a. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - b. Lambert Corporation: [www.lambertusa.com](http://www.lambertusa.com).
    - c. Solomon Colors: [www.solomoncolors.com/sle](http://www.solomoncolors.com/sle).
    - d. Substitutions: See Section 012500 - Product Requirements.
- H. Water: Clean and potable.
- I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
  - 1. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
  - 2. Limitations:
    - a. Use only in combination with masonry units manufactured with integral water repellent admixture.
    - b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
  - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.
  - 4. Products:
    - a. BASF Corp.; MasterPel 210MA: [www.master-builders-solutions.basf.us](http://www.master-builders-solutions.basf.us).
    - b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: [www.euclidchemical.com](http://www.euclidchemical.com).
    - c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: [www.gcpat.com](http://www.gcpat.com).
    - d. Substitutions: See Section 012500 - Product Requirements.

- J. Packaged Dry Material for Mortar for Unit Masonry:
  - 1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
    - a. Mortar Types: As indicated.
    - b. Color(s): As selected by Architect from manufacturer's full range.
    - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
  - 2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
    - a. Manufacturers:
      - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
      - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
      - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
      - 4) Substitutions: See Section 012500 - Product Requirements.
  - 3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
    - a. Manufacturers:
      - 1) Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
      - 2) The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
      - 3) SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
      - 4) Substitutions: See Section 012500 - Product Requirements.
- K. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
  - 1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
  - 2. Manufacturers:
    - a. Amerimix, an Oldcastle brand; [www.amerimix.com](http://www.amerimix.com).
    - b. The QUIKRETE Companies; [www.quikcrete.com](http://www.quikcrete.com).
    - c. SPEC MIX, Inc.; [www.specmix.com](http://www.specmix.com).
    - d. Substitutions: See Section 012500 - Product Requirements.

## 2.5 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
  - 1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
    - a. Fero Corp.; [www.ferocorp.com](http://www.ferocorp.com).
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. Substitutions: See Section 012500 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; Uncoated.
- C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.

1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): Spyra-Lox Rebar Lap- Joint Tie.
- E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 120 Truss-Mesh or 220 Ladder-Mesh.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 344 Rigid Partition Anchor.
- H. Partition Top Anchors: 0.1875 inch thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube; hot dip galvanized to ASTM A153/A153M Class B.
  1. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): PTA-420-HS and PTA Tubes.
- I. Dovetail Anchor Slots for Connecting to Concrete: 2-piece anchors that permit differential movement between masonry and concrete frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
  1. Concrete frame: Dovetail anchors of bent steel, nominal 1 inch width by 1 inch deep by 0.03 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
    - a. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.
- J. Adjustable Anchors for Connecting to Structural Steel Framing: 2-piece anchors that permit differential movement between masonry and steel frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
  1. Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
  2. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): 359/359FP anchors with 301W or VBT ties.
- K. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  1. For cold-formed metal framing and sheathing back-up.

2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
3. Wire ties: Rectangular shape, 0.1875 inch thick.
4. Vertical adjustment: Not less than 2 inches.
5. Basis-of-Design Product: Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com): HB-213 anchors with 2X-HOOK.
- L. Sound Isolating Anchors.
  1. Provide as indicated on the Drawings.
    - a. Basis of Design Product: Provide PSB-M isolators as manufactured by Kinetics. Texture Wire cut or as follows:
      - 1) Mason Industries AB-716.

## 2.6 FLASHINGS

- A. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
  1. Type 304 stainless steel.
    - a. Thickness: 2 mils, minimum.
  2. Basis-of-Design Product: Provide York Manufacturing, Inc.; York 304: [www.yorkmfg.com](http://www.yorkmfg.com), or one of the following products:
    - a. Hohmann & Barnard, Inc.; Mighty-Flash SA: [www.h-b.com](http://www.h-b.com).
    - b. Wire-Bond; Bond-N-Flash SA: [www.wirebond.com](http://www.wirebond.com).
    - c. Substitutions: See Section 012500 - Product Requirements.
  3. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
    - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.
  4. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
    - a. Pre-formed smooth drip plates with hemmed edges.
    - b. Manufacturer shall be the same as stainless steel/polymer fabric flashing manufacturer.
  5. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
    - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.

## 2.7 CAVITY WALL INSULATION

- A. Extruded Polystyrene Board, ASTM C 578-, Type IV, 25 psi minimum compressive strength, unfaced, R5.6 per inch. Provide thickness as indicated on the drawings.
  1. Basis-of-Design: Styrofoam Cavitymate Ultra Extruded Polystyrene Foam Insulation as manufactured by The Dow Chemical Company.
  2. Equal products as manufactured by one of the following companies are also acceptable:
    - a. DiversiFoam Products.
    - b. Owens Corning.
- B. Adhesive and Joint Filler: Type as recommended and approved by the insulation manufacturer.

## 2.8 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.

1. Manufacturers:
  - a. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
  - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
  - c. Substitutions: See Section 012500 - Product Requirements.
- B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
  1. Manufacturers:
    - a. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
    - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
    - c. Substitutions: See Section 012500 - Product Requirements.
- C. Cavity Mortar Control/Drainage Material: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
    - b. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); Mortar Trap or a comparable product by one of the following:
      - 1) Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com).
      - 2) Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
      - 3) Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com).
      - 4) Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
      - 5) Substitutions: See Section 012500 - Product Requirements.
- D. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- E. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
  1. Manufacturers:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com)
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. York Manufacturing, Inc.; [www.yorkmfg.com](http://www.yorkmfg.com)
    - f. Substitutions: See Section 012500 - Product Requirements.
- F. Weep Inserts and Cavity Vents:
  1. Type: Plastic cellular/honeycomb design.
  2. Color(s): As selected by Architect from manufacturer's full range.
  3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); QV Quadro- Vent or a comparable product by one of the following:
    - a. Advanced Building Products Inc.; [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com).
    - b. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - c. Mortar Net Solutions; [www.mortarnet.com](http://www.mortarnet.com).
    - d. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - e. Substitutions: See Section 012500 - Product Requirements.
- G. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
  1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; [www.h-b.com](http://www.h-b.com); MGS or a comparable product by one of the following:
    - a. Heckmann Building Products; [www.heckmannbuildingprods.com](http://www.heckmannbuildingprods.com).
    - b. Wire-Bond; [www.wirebond.com](http://www.wirebond.com).
    - c. Substitutions: See Section 012500 - Product Requirements.
- H. Masonry Cleaners:

1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - a. Basis-of-Design Products: Provide PROSOCO, Inc.; [www.prosoco.com](http://www.prosoco.com): Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
    - 1) Diedrich Technologies, Inc.; [www.diedrichtechnologies.com](http://www.diedrichtechnologies.com).
    - 2) Substitutions: See Section 012500 - Product Requirements.

## 2.9 LINTELS

- A. Masonry Lintels: Masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and weight classification; reinforcing bars as indicated, and filled with grout.
- B. Loose Steel Lintels: Refer to Section 05 5000 - Metal Fabrications.

## 2.10 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  1. Masonry below grade and in contact with earth: Type M.
  2. Exterior, loadbearing masonry: Type S.
  3. Exterior, non-loadbearing masonry: Type N.
  4. Interior, loadbearing masonry: Type N.
  5. Interior, non-loadbearing masonry: Type N.
  6. Precast concrete units: Same Type as wall masonry in which unit is set.
  7. Limestone units: Same Type as wall masonry in which unit is set.
  8. Pointing Mortar: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
  1. Brick Mortar Color: 85X Dark Chocolate.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
  1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that foundations are within tolerances specified.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- E. Verify that reinforcing dowels are properly placed.

### 3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

### 3 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying 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. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

#### 3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Existing Masonry: Match coursing and bonding of existing masonry unless otherwise indicated.
- D. Concrete Masonry Units: Unless otherwise indicated:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
  - 4. Mortar Joint Thickness: 3/8 inch.
- E. Brick Units: Unless otherwise indicated:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.
  - 4. Mortar Joint Thickness: 3/8 inch.

#### 3.3 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- 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. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high-pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
- G. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar, and replace.

- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- J. Cut mortar joints flush where wall tile is scheduled, or resilient base is scheduled.
- K. Isolate the top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
- L. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.
- M. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Allow cleaned surfaces to dry before setting.
  - 3. Wet joint surfaces thoroughly before applying mortar.
  - 4. Rake out mortar joints for pointing with sealant.

#### 3.4 WEEPS INSERTS/CAVITY VENTS

- A. Install weep inserts in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

#### 3.5 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.
- C. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

#### 3.6 HORIZONTAL JOINT REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in the first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry to Structural Steel and Concrete:
  - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under



specific wall type, space anchors at maximum of 24 inches horizontally and 24 inches vertically.

- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8-inch mortar cover to the outside face of the anchor.

### 3.7 MASONRY VENEER REINFORCEMENT AND ANCHORAGE

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Embed ties and anchors in mortar joint and extend into masonry veneer unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

### 3.8 MASONRY FLASHINGS

- A. General:
  - 1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
  - 4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
    - a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
  - 5. Terminate flashing up 8 inches minimum on vertical surface of backing:
    - a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicated.
    - b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
  - 6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Flexible Fabric Flashing:
  - 1. Use factory-fabricated drip plates, corners and end dams.
  - 2. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
  - 3. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
  - 4. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

### 3.9 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
  - 1. Unless otherwise indicated, reinforce as follows:

- a. Openings to 48 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
    - b. Openings from 48 inches to 80 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
    - c. Openings over 80 inches: Reinforce openings as detailed.
  2. Do not splice reinforcing bars.
  3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
  4. Place and consolidate grout fill without displacing reinforcing.
  5. Allow masonry lintels to attain specified strength before removing temporary supports.
  - C. Where the Drawings do not indicate otherwise, provide reinforced unit masonry lintels at all openings and penetrations wider than 12 inches in brick and 24 inches in CMU.
  - D. Maintain minimum 8 inch bearing on each side of opening unless otherwise indicated.
- 3.10 BOND BEAMS

- A. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.
  - B. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web unless otherwise indicated.
  - C. Lap reinforcing bar splices minimum 24 bar diameters, unless otherwise indicated.
  - D. Place and consolidate grout fill without displacing reinforcing.
- 3.11 VERTICAL MASONRY REINFORCEMENT

- A. Reinforcement: Size and place vertical masonry reinforcement to comply with TMS 402/602 requirements and as indicated on Drawings.
  - B. Place and consolidate grout fill without displacing reinforcing.
- 3.12 GROUTING

- A. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
- B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
  1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
- C. Low-Lift Grouting:
  1. Limit height of pours to 12 inches.
  2. Limit height of masonry to 16 inches above each pour.
  3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
  4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- D. High-Lift Grouting:
  1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
  2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
  3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
  4. Place grout for spanning elements in single, continuous pour.

### 3.13 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.
- C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

### 3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
  - 1. Refer to Section 07 9200 - Joint Sealants for sealant installation.
- C. Control Joints to be spaced at no greater than the least of 1.5 times the height of the masonry wall, 24'-0" max, or as shown on design documents. Control Joints shall be provided within 12'-0" or .75 times the height of the masonry wall of the corners of the wall construction.

### 3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, glazed frames, anchor bolts, plates, and reglets and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
  - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

### 3.16 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
    - a. Plus or minus 1/2 inch.
  - 2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
    - a. Minus 1/4 inch.
    - b. Plus 1/2 inch.
  - 3. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
  - 4. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
  - 5. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
  - 6. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
  - 7. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
  - 8. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
  - 9. Lines and Levels:
    - a. Maximum variation from level:
      - 1) Includes, but is not limited to, the following:
        - (a) Lintels.
        - (b) Sills.
        - (c) Parapets.

- (d) Reveals.
      - (e) Other conspicuous lines.
    - 2) Do not vary from level by more than:
      - (a) 1/4 inch in 20 feet.
      - (b) 1/2 inch in 40 feet or more.
    - b. Maximum variation from plumb:
      - 1) Includes, but is not limited to, the following:
        - (a) External corners.
        - (b) Control and expansion joints.
        - (c) Reveals.
        - (d) Other conspicuous lines.
      - 2) Do not vary from plumb by more than:
        - (a) 1/4 inch in 20 feet.
        - (b) 1/2 inch in 40 feet or more.
  - 10. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.
- 3.17 FIELD QUALITY CONTROL
- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- 3.18 CLEANING
- A. Protect surrounding elements and finishes from damage due to cleaning procedures.
  - B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
  - C. Remove excess mortar and mortar droppings.
  - D. Clean soiled surfaces with cleaning solution.
  - E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
    - 1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
      - a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.
  - F. Ground-Face CMU: Refer to Section 09 9100 - Painting for field applied sealer.

END OF SECTION

## SECTION 047200 - CAST STONE MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes cast sills and copings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For cast-stone units, include dimensions and finishes.
- B. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
- C. Samples:
  - 1. For each color and texture of cast stone required.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

### PART 2 - PRODUCTS

#### 2.1 CAST-STONE UNITS

- A. Cast-Stone Units: Comply with ASTM C 1364.
  - 1. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide drips on projecting elements unless otherwise indicated.
- C. Cure Units as Follows:
  - 1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
  - 2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
    - b. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
    - c. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
    - d. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.
- D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- E. Colors and Textures: As indicated on Drawings.

## 2.2 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, or steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.
- B. Dowels: 1/2-inch- (12-mm-) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666 or steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## 2.3 MORTAR

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
  - 1. For setting mortar, use Type N.
  - 2. For pointing mortar, use Type N.

## 2.4 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C 1364.
  - 1. Include one test for resistance to freezing and thawing.

# PART 3 - EXECUTION

## 3.1 SETTING CAST STONE IN MORTAR

- A. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Fill dowel holes and anchor slots with mortar.
  - 2. Fill collar joints solid as units are set.
  - 3. Build concealed flashing into mortar joints as units are set.
  - 4. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
- C. 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.
- D. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.
- G. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
  - 1. Keep joints free of mortar and other rigid materials.
  - 2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.2 INSTALLATION TOLERANCES

- A. Variation from Plumb: 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 1/2 inch (12 mm) maximum.
- 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 1/2 inch (12 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 vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
  - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 047313 - CALCIUM SILICATE MANUFACTURED STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Dolomite limestone base course.
- B. Related Requirements
  - 1. Section 042000 - Unit Masonry.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type and color of exposed
- C. Test Reports: Test results prepared by an independent testing agency, indicating tested material characteristics as part of a source quality control program, current within the past five (5) years.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer having sufficient plant facilities to produce the shapes, quantities and size of Products required in accordance with the project schedule.
- B. Installer: Company or person specializing in commercial masonry work with 10 years documented experience.
- C. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
  - 1. Samples to be 4'-0 x 4'-0 for typical exterior wall.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver calcium silicate masonry units in protective film. Prevent damage to units.
- B. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.
- C. Store units in a manner designed to prevent damage and staining of units.
- D. Stack units on timbers or platforms at least 3 inches above grade.
- E. Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for extended periods of time.
- F. Cover stored units with protective enclosure if exposed to weather.
- G. Do not use salt or calcium-chloride to remove ice from masonry surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of calcium silicate masonry units having Products considered acceptable for use:
  - 1. Arriscraft.



## 2.2 MATERIALS

- A. Dolomitic Limestone (Referred to as “Marble Grade Stone” on the drawings): Base Course Material, to ASTM C568, Category III – High-Density; special shapes as indicated; (ST-1)
  - 1. Physical Properties: having the following typical average properties when tested to the identified standard:
    - a. Compressive Strength: 22,900 psi, to ASTM C170.
    - b. Absorption: 0.75 percent, to ASTM C97.
    - c. Density: 167 lb/ft<sup>3</sup>, to ASTM C97.
    - d. Modulus of Rupture: 2,250 psi, to ASTM C99.
    - e. Flexural Strength: 1,600 psi, to ASTM C880.
    - f. Abrasion Resistance: 18.0, to ASTM C241.
  - 2. Product and Manufacturer’s Name: Adair® Masonry Units by Arriscraft.
  - 3. Finish: medium dressed finish on exposed faces and ends.
  - 4. Dimensions:
    - a. Bed Thickness: 3-5/8” thick.
    - b. Unit Length: 23-5/8” long.
    - c. Unit Height: 7-5/8” high.
  - 5. Color and Pattern: Sepia color, fleuried pattern, to match approved sample range.
- B. Mortar: 1:1:6 Portland cement-hydrated lime-sand mix, as specified in Section 042000.
- C. Grout: maximum 6,500 psi at 28 days, as specified in Section 042000.
- D. Wall Ties and Anchorages: as specified in Section 042000.
- E. Flashing, Vents, and Masonry Accessories: as specified in Section 042000.

## 2.3 FABRICATION TOLERANCES

- A. Fabricate calcium silicate masonry units to the following tolerances:
  - 1. Unit Length: plus or minus 1/16”.
  - 2. Unit Height: plus or minus 1/16”.
  - 3. Deviation From Square: plus or minus 1/16”, with measurement taken using the longest edge as the base.
  - 4. Bed Depth: plus or minus 1/8”.
  - 5. Custom Unit Dimensions: plus or minus 1/8”.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify site conditions are ready to receive work.
- B. Inspect materials for fit and finish prior to installation. Do not set unacceptable units.
- C. Beginning of installation means acceptance of existing conditions.

### 3.2 CUTTING MASONRY UNITS

- A. Cut masonry units with wet-saw.
- B. Pre-soak units using clean water prior to cutting.
- C. Clean cut units using a stiff fiber brush and clean water. Allow units to surface dry prior to placement.
- D. Finish cut edges to match face when exposed in wall.

### 3.3 WETTING MASONRY UNITS

- A. Where the ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph, pre-wet masonry units.
- B. Lay wetted units when surface dry.

### 3.4 COURSING

- A. Place masonry to lines and levels indicated.
- B. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
- C. Lay masonry units in half-running bond.
- D. Course one masonry unit and one mortar joint to equal 4, 8 and 12 inches.
- E. Maintain mortar joint thickness of 3/8 inch.
- F. Tool mortar joints by compacting the surface when thumbprint hard, to a concave finish.

### 3.5 PLACING AND BONDING

- A. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, [and] deep or excessive furrowing of mortar joints are not permitted.
- B. Fully bond intersections, and external corners.
- C. Do not adjust masonry units after laying. Where resetting of masonry is required, remove, clean units and reset in new mortar.
- D. Install wall ties and anchorages as specified in Section 042000.
- E. Install flashings, vents, and masonry accessories as specified in Section 042000.

### 3.6 SITE TOLERANCES

- A. Erect masonry within the tolerances described in TMS 602, PART 3.3F.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed masonry and reject masonry that is chipped, cracked, or blemished (streaked, stained or otherwise damaged), as described below.
  - 1. Masonry will be inspected to be free of cracks or other blemishes on the finished face or front edges of the masonry units exceeding 3/8 inch or that can be seen from a distance of 20 feet.
  - 2. Units shall exhibit a texture approximately equal to the approved sample when viewed under diffused daylight illumination at a 20-foot distance.
  - 3. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under diffused daylight illumination from a 20-foot distance.
  - 4. Efflorescence will not be cause for rejection.

### 3.8 ADJUSTING AND CLEANING

- A. Repair chips on smooth finished units with patch kits furnished by manufacturer.
- B. Clean masonry units as specified in Section 042000.
  - 1. Protect windows, sills, doors, trim and other work from damage.
  - 2. Remove large particles with [stiff fiber brushes] [wood paddles] without damaging surface.
  - 3. Saturate masonry with clean water and flush off loose mortar and dirt.

4. Dilute cleaning agent with clean water in controlled proportions.
  5. Apply solution to pre-soaked wall surface using [soft-bristled brush] [low pressure acid-resistant sprayer].
  6. Thoroughly rinse cleaning solution and residue from wall surface.
- C. Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

### 3.9 PROTECTION

- A. Protect units from damage resulting from subsequent construction operations.
- B. Use protection materials and methods which will not stain or damage units.
- C. Remove protection materials upon Substantial Performance of the Work, or when risk of damage is no longer present.

END OF SECTION 047313

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Requirements:
  - 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

#### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Testing and inspecting or special inspections required by IBC.
- D. Field quality-control and special inspection reports.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using schematic details indicated and AISC 360.
  - 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Combined system of moment frame, braced frame, and shear walls.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
  - 1. Configuration: Hooked.
  - 2. Finish: Plain.
- A. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
  - 1. Finish: Plain.
- B. Threaded Rods: ASTM A 36/A 36M.
  - 1. Finish: Plain .

## 2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
- B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

## 2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened or Pretensioned as indicated on the drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.
  - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
  - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a

minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
  - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - 1. Liquid Penetrant Inspection: ASTM E 165.
  - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  - 3. Ultrasonic Inspection: ASTM E 164.
  - 4. Radiographic Inspection: ASTM E 94.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

### 3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened or Pretensioned as indicated on the drawings..
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tab, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.

END OF SECTION 051200



## SECTION 05 1213 ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

### 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 architecturally exposed structural-steel (AESS).
  - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.

#### 1.3 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches vertically and 36 inches horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet vertically and horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents

#### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

#### 1.6 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Indicate exposed surfaces and edges and surface preparation being used.
6. Indicate special tolerances and erection requirements.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

#### 1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, Endorsement P2, or Endorsement P3 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
- B. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

#### 1.10 FIELD CONDITIONS

- A. Field Measurements: Where AECS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
- B. Finish: Plain

- C. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

## 2.2 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

## 2.3 PRIMER

- A. Primer: Comply with Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."

## 2.4 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
  - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
  - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
  - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
  - 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
  - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
  - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
  - 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
  - 8. Fabricate Category 2 and Category AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
  - 9. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for Category 1 AESS.
  - 10. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
  - 11. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
  - 12. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.
  - 13. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch for Category AESS.
  - 14. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

15. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
16. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
17. Cut, drill, or punch holes perpendicular to steel surfaces.
18. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
19. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Joint Type: Snug tightened
- C. Weld Connections: Comply with AWS D1.1/D1.1M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
  1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
  2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
  3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 AESS is exposed to weather.
  4. Provide continuous welds of uniform size and profile where Category 1 AESS is welded
  5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for Category 1 and Category 2 AESS.
  6. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm) for Category 1 and Category 2 AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
  7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
  8. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
  9. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.
  10. Make fillet welds for Category 1 and Category 2 AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

## 2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches .
  2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.
- B. Surface Preparation for Nongalvanized Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
  3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
  4. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
  5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
  6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
  8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
  9. SSPC-SP 8, "Pickling."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- E. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- F. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- C. Examine AECS for twists, kinks, warping, gouges, and other imperfections before erecting.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AECS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
- B. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
- C. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
- C. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- D. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Joint Type: Snug tightened.
- C. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
- D. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
- E. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, grind smooth.
- F. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

### 3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- C. 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.
- D. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- E. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- F. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 05 1213

## SECTION 052100 - STEEL JOIST FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. K-series steel joists.
  - 2. K-series steel joist substitutes.
  - 3. Joist girders.
  - 4. Joist accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
  - 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Manufacturer certificates.
- C. Mill Certificates: For each type of bolt.
- D. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.5 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.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
  - 1. Use ASD; data are given at service-load level.
  - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
    - a. Roof Joists: Vertical load deflection of 1/240 of the span.

### 2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specification 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.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. 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).

### 2.3 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

### 2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Furnish 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.
- C. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
  - 1. Finish: Plain
- D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

### 2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.
- B. Apply one coat of shop primer to joists and joist accessories.



## PART 3 - EXECUTION

### 3.1 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 instructions, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "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 bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100

## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof deck.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
  - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Evaluation reports.
- D. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

#### 2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet at exterior applications: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
  - a. Color: Manufacturer's standard.
3. Deck Profile: Type WR, wide rib.
4. Profile Depth: 1-1/2 inches (38 mm).
5. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).

## 2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (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. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- G. Galvanizing Repair Paint: ASTM A 780/A 780M.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
- G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.
- H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- I. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- J. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

### 3.3 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

END OF SECTION 053100

## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Load-bearing wall framing.
  - 2. Exterior non-load-bearing wall framing.
  - 3. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - 3. Include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product certificates.
- C. Product test reports.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  - 1. Wall Studs: AISI S211.
  - 2. Headers: AISI S212.
  - 3. Lateral Design: AISI S213.
- B. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
  - 1. Design framing systems to withstand wind load per current MBC without deflections greater than  $l/600$  of the wall height.
  - 2. 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 (range) of 120 Deg F (67 Deg C).
  - 3. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
  - 4. Design exterior framing to accommodate lateral deflection without regard to contribution of sheathing materials.
  - 5. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.
  - 6. Provide Cee studs of depth indicated at maximum 16" on center, 20-gage minimum.
  - 7. Provide deep leg slip track connection as required under structural steel framing.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

### 2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 (Z180)
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance
  - 2. Coating: G60 (Z180).

### 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, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm) minimum.
  - 2. Flange Width: 1-5/8 inches (41 mm) minimum.
  - 3. Section Properties: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

## 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/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

## 2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: MIL-P-21035B or SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- 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 equal 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 joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.3 NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.



1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
  1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  2. Strap 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.
  3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.4 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Miscellaneous steel framing and supports.
  - 2. Shelf angles.
  - 3. Metal ladders.
  - 4. Ladder safety cages.
  - 5. Miscellaneous steel trim.
  - 6. Metal bollards.
  - 7. Loose bearing and leveling plates.
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels.
  - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
  - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Zinc-Coated Steel Wire Rope: ASTM A 741.
  - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, with G90 (Z275) coating.
- I. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- J. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- K. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- L. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
  - 2. Provide stainless-steel fasteners for fastening stainless steel.
  - 3. Provide stainless-steel fasteners for fastening nickel silver.
  - 4. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1 (A1)] [Group 2 (A4)] stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. 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.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

## 2.7 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.
- C. Galvanize shelf angles located in exterior walls.

## 2.8 METAL LADDERS

- A. General: Comply with ANSI A14.3.
- B. Steel Ladders:
  - 1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
  - 2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
  - 3. Rungs: 1-inch- (25-mm-) diameter steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung.
  - 6. Galvanize exterior ladders, including brackets.

## 2.9 LADDER SAFETY CAGES

- A. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
- B. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
- C. Prime steel ladder safety cages, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

## 2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize exterior miscellaneous steel trim.

## 2.11 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
  - 1. Each bollard to be furnished with a precast concrete dome for field installation as bollards are set.
  - 2. Precast concrete domes are to be manufactured by TopGuard LLC or approved equal.
  - 3. Galvanize exterior bollards.

2.12 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.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels located in exterior walls.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 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.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer.
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLING 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 nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and install precast concrete dome per manufacturer's instructions. Allow concrete to cure seven days before installing.
- B. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

## SECTION 055100 - METAL RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel pipe handrails attached to walls adjacent to metal stairs and ramps.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For metal pan stairs, grout and anchoring cement.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

#### 1.3 QUALITY ASSURANCE

- A. 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.
  - 1. Preassembled Stairs: Commercial class.
  - 2. Industrial- Type Stairs: Industrial class.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.

#### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed).
- D. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.



## 2.3 FASTENERS

- A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Provide anchors for embedding units in concrete or CMU walls, either integral or applied to units, as standard with manufacturer.

## 2.5 FABRICATION, GENERAL

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- C. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

## 2.6 STAIR RAILINGS AND GUARDRAILS

- A. Steel Pipe Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: 1-1/2-inch diameter standard steel pipe top and bottom rails and posts.
  - 2. Handrails: 1-1/4-inch diameter standard steel pipe.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.
- C. Form changes in direction of railings by bending or by inserting prefabricated elbow fittings.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails.

- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
- H. 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.

## 2.7 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended for interior and exterior applications.

## 2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
  - 1. Anchor posts to steel by welding to steel supporting members.
  - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post installed anchors and bolts.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed ¼ inch in 12 feet.
- B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
- C. 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 nonshrink, nonmetallic grout.
- D. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts and fill annular space between post and sleeve with nonshrink, nonmetallic grout.

### 3.2 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 same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 055100

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Framing with dimension lumber.
  - 2. Wood blocking and nailers.
  - 3. Wood furring and grounds.
  - 4. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Fire-retardant-treated wood.
  - 3. Power-driven fasteners.
  - 4. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less.

2.2 WOOD-PRESERVATIVE-TREATED MATERIAL

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction and Category UC3b for exterior construction.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, 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.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat all miscellaneous carpentry unless otherwise indicated, items indicated on Drawings, and the following:
  1. Framing for raised platforms.
  2. Concealed blocking.
  3. Roof framing and blocking.
  4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
  5. Plywood backing panels.

## 2.4 DIMENSION LUMBER FRAMING

- A. Framing: No. 2 grade of any of the following species:
  1. Hem-fir (north); NLGA.
  2. Southern pine; SPIB.
  3. Douglas fir-larch; WCLIB or WWPA.
  4. Hem-fir; WCLIB or WWPA.

## 2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  1. Blocking.
  2. Nailers.
  3. Furring.
  4. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
  1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2. Eastern softwoods; No. 2 Common grade; NeLMA.
3. Northern species; No. 2 Common grade; NLGA.
4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

## 2.7 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

## 2.8 METAL FRAMING ANCHORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Cleveland Steel Specialty Co.
  2. KC Metals Products, Inc.
  3. Phoenix Metal Products, Inc.
  4. Simpson Strong-Tie Co., Inc.
  5. USP Structural Connectors.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. 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. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
  1. Use for wood-preservative-treated lumber and where indicated.

## 2.9 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.

END OF SECTION 061000

## SECTION 061600 - SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wall sheathing.
  - 2. Parapet sheathing.
  - 3. Sheathing joint and penetration treatment.
- B. Related Requirements:
  - 1. Section 072713 "Modified Bituminous Air Barriers" for waterproof barrier applied over sheathing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preserved-treated plywood.
  - 2. Fire-retardant-treated plywood.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

#### 2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction and Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

#### 2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with

fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.
  - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

#### 2.4 WALL SHEATHING

- A. Plywood Sheathing: DOC PS 1 Exterior, Structural I sheathing.
  - 1. Location: Entry canopies at main entrance and classroom wings.
- B. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Corp.
    - b. National Gypsum Co.; Gold Bond Building Products Division.
    - c. USG Corp.; United States Gypsum Co.
  - 2. Type and Thickness: Regular, 1/2 inch (13 mm).
  - 3. Location: All locations unless otherwise indicated.

#### 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For parapet and wall sheathing provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.



1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

## 2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## 2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  3. ICC-ES evaluation report for fastener.
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

## 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  1. Wall Sheathing:
    - a. Screw to cold-formed metal framing.
    - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

### 3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with nails or screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
  - 4. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Plastic-laminate cabinets.
  - 2. Plastic-laminate countertops.
  - 3. Solid-surface counter-tops and sills.
  - 4. Interior standing and running trim.
  - 5. Miscellaneous shelving and clothes rod.
  - 6. Miscellaneous framing and brackets.
- B. Related Sections include the following:
  - 1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

#### 1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

#### 1.3 SUBMITTALS

- A. Product Data: For particleboard, plywood, high-pressure decorative laminate, adhesive for bonding plastic laminate, fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
- C. Samples for each exposed product and for each color and texture specified.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork 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. 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.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish 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 established dimensions.

## 1.6 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 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 3. Softwood Plywood: DOC PS 1, Medium Density Overlay.
  - 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
  - 5. Trim: Premium grade in accordance with AWI Section 300; maximum moisture content of 6 percent; White Birch, vertical or flat grain, for a transparent finish.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
  - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
    - a. As indicated on Drawings.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2
  - 1. Manufacturers: As indicated on Drawings.

### 2.2 PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay.

- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: HGS.
  - 2. Vertical Surfaces: HGS.
  - 3. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
- E. Materials for Semi exposed Surfaces: Provide surface materials indicated below:
  - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
  - 2. Drawer Sides and Backs: Solid-hardwood lumber.
  - 3. Drawer Bottoms: Hardwood plywood.
- F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As indicated on Drawings.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- D. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware".
- E. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
  - 1. Provide minimum two hinges per door.
  - 2. Provide minimum three hinges for doors over 36 inches tall.
  - 3. Provide minimum four hinges for doors over 60 inches tall.
- D. Wire Pulls: Back mounted, 4 inches long, 5/16 inches in diameter, polished chrome finish.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 and BHMA A156.9, B04102; with shelf brackets, B04112.
  - 1. 32 MM system is also acceptable.
- G. Shelf Rests: BHMA A156.9, B04013.
- H. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
  - 1. Box Drawer Slides: 75 lbf.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color to match laminate color.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.
- B. Grade: Premium.

- C. High-Pressure Decorative Laminate Grade: HGS.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As indicated on Drawings.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- F. Core Material: Particleboard made with exterior glue.
- G. Core Material at Sinks: Particleboard made with exterior glue.

## 2.5 SOLID-SURFACING-MATERIAL COUNTERTOPS AND SILLS

- A. Solid-Surfacing-Material Thickness: minimum ½ inch or greater where shown on the drawings.
- B. Colors, Patterns, and Finishes: As indicated on Drawings.
- C. Fabricate tops in one piece with shop-applied backsplashes. Comply with solid-surfacing-material manufacture's written recommendations for adhesives, sealers, fabrication, and finishing.

## 2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. 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 sleeves for drilled-in-place anchors.
- C. Glue: Aliphatic resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer. Do not use adhesives that contain urea formaldehyde.
- E. Workstation Countertop Support Brackets: Provide brackets as indicated on Drawings.
  - 1. Space brackets at maximum 36" centers.
  - 2. See drawings for additional information and details.
- F. Clothes Rods: 1-1/16-inch diameter, chrome finish steel with 0.109 inch thickness and matching flanges. (K & V No. 770-1 series with No. 734 CHR and 735 CHR brackets or equal.

## 2.7 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Premium grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. 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 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 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. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.
- F. Fabricate to AWI premium standards.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including 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 level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.
- 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.
  - 1. Scarf running joints and stagger in adjacent and related members.
  - 2. Fill gaps, if any, between top of base and wall with [plastic wood filler; sand smooth; and finish same as wood base if finished] [latex sealant, painted to match wall].
  - 3. 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 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 installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

### 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. Touch up finishing work specified in this Section after installation of interior architectural woodwork. Fill nail holes with matching filler where exposed
- D. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023



## SECTION 066400 - PLASTIC PANELING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.
2. Factory-laminated plastic sheet paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling in manufacturer's standard sizes.

#### 1.3 QUALITY ASSURANCE

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. As indicated in "Finish Material Legend".
2. Substitutions: Refer to section 012500

## 2.2 ACCESSORIES

- A. Sealant: Latex sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

## 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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
  - 2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
  - 1. Drill oversized fastener holes in panels and center fasteners in holes.
  - 2. Apply sealant to fastener holes before installing fasteners.

- D. Install factory-laminated panels using concealed mounting splines in panel joints.
- E. Install trim accessories with adhesive. Do not fasten through panels.
- F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Extruded polystyrene foam-plastic board used for the following applications:
    - a. Building perimeter foundation insulation.
    - b. Thermal breaks at exterior curbs and slabs at perimeter of building.
    - c. Concealed building insulation not specified as part of specification sections for Unit Masonry and Metal Wall and Roof Panel assemblies.
  - 2. Mineral-wool blanket insulation used as a thermal barrier at the following applications:
    - a. Framed wall assemblies where shown on the drawings.
    - b. Filling miscellaneous voids where shown on the drawings.
- B. Related Requirements:
  - 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
  - 2. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
  - 3. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards."
- B. Extruded Polystyrene Board, for below grad applications: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The)
    - c. Owens Corning.
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
  - 3. Thickness as indicated on drawings.
  - 4. Provide 40-psi (276 - kPa) compressive strength board at all horizontal applications.
- C. Extruded Polystyrene Board for above grade, concealed building insulation use: ASTM C 578-, Type IV, 25 psi minimum compressive strength, unfaced, R5.6 per inch. Provide thickness as indicated on the drawings.
  - 1. Basis-of-Design: Styrofoam Cavitymate Ultra Extruded Polystyrene Foam Insulation as manufactured by The Dow Chemical Company.
  - 2. Equal products as manufactured by one of the following companies are also acceptable:
    - a. DiversiFoam Products.
    - b. Owens Corning.

- D. Adhesive and Joint Filler: Type as recommended and approved by the insulation manufacturer.

## 2.2 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

## ACCESORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Mineral Wool Insulation: Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.2 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

### 3.3 INSTALLATION OF INSULATION IN CONCEALED BUILDING AREAS

- A. Extruded Polystyrene Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit

courses of insulation between wall framing and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

- B. Seal all joints, gaps and voids with joint filler.

### 3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket installation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use installation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place installation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Mineral-wool Insulation, where indicated on Drawings.
  - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions, where indicated on Drawings.

### 3.5 PROTECTION

- A. Protect installed insulation 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 072100

## SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Self-adhering, vapor-retarding, modified bituminous sheet air barriers used where Metal Siding Panels are applied over wall sheathing and at flashing locations.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

#### 2.2 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide GCP Applied Technologies Inc. (formerly Grace Construction Products); "Perm-A-Barrier Wall Membrane" or equal products as manufactured by one of the following manufacturers:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. Meadow, W.R., Inc.
    - c. Tremco Incorporated, an RPM company.
  - 2. Physical and Performance Properties:
    - a. Air Permeance: Maximum 0.001 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
    - b. Tensile Strength: Minimum 400 psi (2.8 MPa); ASTM D 412, Die C.
    - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
    - d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E 154.
    - e. Water Absorption: Maximum 0.10 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
    - f. Vapor Permeance: Maximum 0.05 perm (2.9 ng/Pa x s x sq. m); ASTM E 96/E 96M, Water Method.

#### 2.3 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.

- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- D. Sealant: One part neutral curing, ultra-low modulus silicone sealant for sealing penetrations and terminations.

### PART 3 - EXECUTION

#### 3.1 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- B. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- C. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

#### 3.2 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
  - 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 air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. 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 airtight installation.
  - 1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
  - 2. Roll sheets firmly to enhance adhesion to substrate.
- D. Seal top of through-wall flashings to air-barrier sheet.
- E. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- F. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
- G. Fill gaps in miscellaneous penetrations of air-barrier membrane with sealant.
- H. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- I. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- J. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.



### 3.3 FIELD QUALITY CONTROL

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 60 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

END OF SECTION 072713

## SECTION 074213.13 - FORMED METAL WALL PANELS

### PART 1 - PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes concealed-fastener, lap-seam metal wall panels.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples for Initial Selection: For each product specified. Provide representative color charts of manufacturer's full range of colors.
- D. Samples for Verification: Provide 12-inch (300 mm) section of panel(s) showing finishes. Provide 12-inch (300 mm) long pieces of trim pieces and other exposed components.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal wall panel and panel accessories from a single manufacturer.
- B. Wall Systems Installer Qualifications: Experienced Installer with minimum of 5 years' experience with successfully completed projects of a similar nature and scope.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. 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 panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated for disengagement, per ASTM E 72.
  - 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.

2. Limits of Deflection: Metal wall panel assembly shall withstand scheduled wind pressure with the following allowable deflection:
    - a. Maximum allowable deflection limited to  $L/180$  deflection of panel perimeter normal to plane of wall with no evidence of failure.
  3. Secondary Metal Framing: Design secondary metal framing for metal wall panel assembly according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
  4. Side Joint Disengagement: Panels must be designed and tested under Negative load per ASTM E 72.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

## 2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Wall Panels (**MP-1, MP-2**): Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
1. Basis-of-Design: PAC-CLAD, Flush Wall panels.
    - a. Subject to meeting the specified requirements, formed metal wall panels by the following manufacturers are also acceptable:
      - 1) CENTRIA
      - 2) Substitutions: See Section 012500 - Product Requirements
  2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 20-gage (0.91 mm).
    - b. Surface: Smooth.
    - c. Panel Coverage: VARIES.
    - d. Panel Height: 1 inches (38 mm).
    - e. Exterior Finish: Three-coat fluoropolymer.
    - f. Color: Provide colors as indicated on Drawings:

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fascia, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels 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 panels.

- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Where exposed fasteners cannot be avoided, supply stainless steel fasteners with heads matching color of metal wall panels by means of factory-applied coating.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

## 2.4 FINISHES

- A. Panels and Accessories:
  - 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine metal wall panel substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal wall panels.
- B. Wall Substrate: Confirm that wall substrate is within tolerances acceptable to metal wall panel system manufacturer.
  - 1. Maximum deviations acceptable:
    - a. 1/4-inch in 20 feet (6.4 mm in 6 m) vertically or horizontally from face plane of framing.
    - b. 1/2-inch (12.7 mm) across building elevation.
    - c. 1/8-inch in 5 feet (3.2 mm in 1.5 m).
- C. Framing: Inspect framing that will support metal wall panels to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal wall panels.
- D. Openings: Verify that window, door, louver and other penetrations match layout on shop drawings.
- E. Air/Moisture Barriers: Confirm that work has been completed, inspected, and tested as required.
- F. Installer shall provide written summary of out-of-tolerance work and other deficient conditions prior to proceeding with metal wall panel system installation.
- G. Correct out of tolerance work and other deficient conditions prior to proceeding with panel installation.

### 3.2 SECONDARY FRAMING INSTALLATION

- A. Secondary Metal Subgirt Framing: Install secondary metal framing components to tolerances indicated, as shown on approved shop drawings. Install secondary metal framing and other metal panel supports per ASTM C 1007 and metal wall panel manufacturer's recommendations.

### 3.3 METAL PANEL INSTALLATION

- A. General: Install metal wall panels in accordance with approved shop drawings and manufacturer's recommendations. Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement

- B. Attach panels to metal framing using recommended clips, screws, fasteners, sealants, and adhesives indicated on approved shop drawings.
  - 1. Fasteners for Steel Wall Panels: Stainless-steel for exterior locations and locations exposed to moisture; carbon steel for interior use only.
  - 2. Fasten metal wall panels to supports with fasteners and spacing recommended by manufacturer.
  - 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
  - 4. Dissimilar Materials: Where elements of metal wall panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
- C. Joint Sealers: Install joint sealants where indicated on approved shop drawings.

### 3.4 ACCESSORY INSTALLATION

- A. General: Install metal wall panel accessories with positive anchorage to building and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install related flashings and sheet metal trim per requirements of Division 07 Section "Sheet Metal Flashing and Trim."
  - 2. Install components required for a complete metal wall panel assembly, including trim, copings, corners, lap strips, flashings, sealants, fillers, closure strips, and similar items.
  - 3. Comply with performance requirements and manufacturer's written installation instructions.
  - 4. Provide concealed fasteners except where noted on approved shop drawings.
  - 5. Set units true to line and level as indicated.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report.
- B. Correct deficiencies noted in manufacturer's report.

### 3.6 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.13

## SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Mechanically fastened, polyvinyl chloride (PVC) roofing system.
  - 2. Roof insulation.
  - 3. Walkways.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
  - 1. Layout and thickness of insulation.
  - 2. Base flashings and membrane terminations.
  - 3. Flashing details at penetrations.
  - 4. Tapered insulation thickness and slopes.
  - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
  - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  - 7. Tie-in with air barrier.
- C. Samples: For the following products:
  - 1. Roof membrane and flashing, of color required.
  - 2. Walkway pads or rolls, of color required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates:
  - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
    - a. Submit evidence of compliance with performance requirements.
  - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- C. Research reports.

- D. Field Test Reports:
  - 1. Concrete internal relative humidity test reports.
  - 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- E. Field quality-control reports.
- F. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this section, signed by installer, covering Work of this Sections, including all components of roofing system such as roofing pavers, and walkway products, for the following warranty period.
  - 1. Warranty period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272/D 4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
- E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

## 2.2 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle SynTec Incorporated.
    - b. Duro-Last Roofing, Inc.
    - c. Flex Membrane International Corp.
    - d. GAF.
    - e. Johns Manville; a Berkshire Hathaway company.
    - f. Substitutions: See Section 012500 - Product Requirements.
  - 2. Membrane Thickness: 60 mils (1.5 mm).
  - 3. Exposed Face Color: White.

## 2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  - 1. Adhesives and sealants shall comply with the following limits for VOC content:
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesives: 80 g/L.
    - f. PVC Welding Compounds: 510 g/L.
    - g. Other Adhesives: 250 g/L.
    - h. Single-Ply Roof Membrane Sealants: 450 g/L.
    - i. Nonmembrane Roof Sealants: 300 g/L.
    - j. Sealant Primers for Nonporous Substrates: 250 g/L.
    - k. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- E. 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.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to 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.

## 2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
  - 1. Material: Match roof insulation.
  - 2. 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. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
  - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
  - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
  - 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
  - 4. Adhesives and sealants shall comply with the following limits for VOC content:
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesives: 80 g/L.
    - f. PVC Welding Compounds: 510 g/L.
    - g. Other Adhesives: 250 g/L.
    - h. Single-Ply Roof Membrane Sealants: 450 g/L.
    - i. Nonmembrane Roof Sealants: 300 g/L.
    - j. Sealant Primers for Nonporous Substrates: 250 g/L.
    - k. Sealant Primers for Porous Substrates: 775 g/L.

## 2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls,
  - 1. Products: Subject to compliance, provide Plastex; Crossgrip PVC two layer walkway matting.
    - a. Height: 9/16 inch (14 mm) thick.
    - b. Width: 36 inches (914 mm).
    - c. Color: Light grey.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

### 3.2 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
  - 1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

### 3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
  - 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows, and with long joints continuous at right angle to flutes of decking.
    - a. Locate end joints over crests of decking.
    - b. 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.
    - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
      - 1) Trim insulation so that water flow is unrestricted.
    - f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    - g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    - h. Loosely lay base layer of insulation units over substrate.
    - i. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
      - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
      - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
  - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
    - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    - b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

- d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
- e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
- f. Trim insulation so that water flow is unrestricted.
- g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- i. Loosely lay each layer of insulation units over substrate.
- j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
  - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equi-viscous temperature.
  - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
  - 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.5 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.
- D. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
- I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings 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 roof membrane and sheet flashings.
  - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to 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 and mechanically anchor to substrate through termination bars.

3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
  - 1. Install flexible walkways at the following locations:
    - a. Locations indicated on Drawings.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system 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 roofing system that does not comply with requirements, repair substrates, and repair or reinstall 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.

END OF SECTION 075419

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formed low-slope roof sheet metal fabrications.
  - 2. Formed wall sheet metal fabrications.
  - 3. Self-adhering underlayment.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Distinguish between shop- and field-assembled work.
  - 3. Include identification of finish for each item.
  - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Special warranty.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty: Installer's standard form in which the installer agrees to repair or replace the reused and repaired standing-seam copper roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; 2B (bright, cold rolled) finish.

- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
  - 1. Surface: Smooth, flat.
  - 2. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 3. Color: As selected by Architect from manufacturer's full range including custom colors.
  - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. Carlisle Residential; a division of Carlisle Construction Materials.
    - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
    - d. Henry Company.
    - e. Substitutions: See Section 012500 - Product Requirements.
  - 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
  - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

- c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, 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.
- D. 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.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 1. Obtain field measurements for accurate fit before shop fabrication.
  - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

## 2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from the following materials:
  - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.
- B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.



- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Galvanized Steel: 24 Gage, 0.022 inch (0.56 mm) thick.
- D. Roof-Penetration Flashing: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

## 2.7 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, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- B. Opening Flashings 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 materials:
  - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## PART 3 - EXECUTION

### 3.1 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

### 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, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. 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.
  - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  - 5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or

by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.3 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  2. Extend counterflashing 4 inches (100 mm) over base flashing.
  3. Lap counterflashing joints minimum of 4 inches (100 mm).
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

### 3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry." Section 047200 "Cast Stone Masonry."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

### 3.5 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.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof hatches.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The); Single Leaf Roof Scuttle Type E-50 or a comparable product by one of the following:
    - a. Architect approved equal. Substitutions: See Section 012500 - Product Requirements.
- B. Type and Size: Single-leaf lid, 36 by 36 inches.
- C. Hatch Material: Aluminum sheet.
  - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  - 2. Finish: Mill.
- D. Construction:
  - 1. Insulation: Cellulosic-fiber board.
  - 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.

3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
- E. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- F. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
  1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  2. Height: 42 inches (1060 mm) above finished roof deck.
  3. Material: Aluminum.
  4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
  5. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's full range.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
  1. Height: 42 inches above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches
  3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (in diameter).
  4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  7. Fabricate joints exposed to weather to be watertight.
  8. Fasteners: Manufacturer's standard, finished to match railing system.
  9. Finish: Manufacturer's standard
    - a. Color: As selected by Architect from manufacturer's full range

## 2.2 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  1. Mill Finish: As manufactured.
  2. Concealed Finish: Pretreat with 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 and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

## 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- D. Underlayment:
  - 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
  - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
  - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- H. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact

surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

### 3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078100 - SPRAY-APPLIED 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes Sprayed-Applied Fire-Resistive Materials (SFRMs).

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans, schedules, or both, indicating the following:
  - 1. Extent of fireproofing for each construction and fire-resistance rating.
  - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of fireproofing after application.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from third party.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.



## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups Indicate portion of Work represented by mockup on Drawings or draw mockup as separate element.
  - 1. Build mockup of as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. It is recommended that industry guidelines as noted in National Fireproofing Contractors Association (NFCA) 100 – Standard Practice for the Application of Spray-Applied Fire Resistive Materials (SFRMs) be maintained on the project site.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on fireproofing.
  - 1. Provide test specimens and assemblies representative of proposed materials and construction.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
  - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
  - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 40 deg F 4.4 deg C or lower unless temporary protection and heat

are provided to maintain temperature at or above this level for 24 hours prior to, during, and for 24 hours after product application.

- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing a minimum 4 complete air exchanges per hour and according to manufacturer's written instructions until Spray-Applied Fire Resistive Materials are dried and cured. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119/UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.
- E. Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Asbestos: Provide products containing no detectable asbestos.

### 2.2 SPRAY-APPLIED FIRE RESISTIVE MATERIALS

- A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Concealed/Commercial SFRMs:
    - a. ISOLATEK International: CAFCO® 300 Series (ISOLATEK® Type 300 Series), CAFCO® BLAZE-SHIELD® II (ISOLATEK® Type II)
      - 1) Substitutions: See Section 012500 - Product Requirements.
    - b. Physical Properties:

- 1) Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
- 2) Density: Not less than 15 lb/cu. ft. (240 kg/cu. m) as specified in the approved fire-resistance design, according to ASTM E 605.
- 3) Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
- 4) Combustion Characteristics: When tested in accordance with ASTM E 136 shall be noncombustible.
- 5) Surface-Burning Characteristics: When tested in accordance with ASTM E 84 or CAN4-S102, the material shall exhibit the following surface burning characteristics:
  - a) Flame Spread Index [10] or less
  - b) Smoke Developed [10] or less
- 6) Compressive Strength: When tested in accordance with ASTM E 761, the material shall not deform more than 10 percent when subjected to a crushing force of 1,440 psf (68.9 kPa).
- 7) Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
- 8) Deflection: No cracking, spalling, or delamination according to ASTM E 759.
- 9) Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
- 10) Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
- 11) Fungal Resistance: When tested in accordance with ASTM G 21, the material shall show resistance to mold growth for a minimum period of 28

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing 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: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
  1. Fireproofing manufacturer shall be contacted for procedures on handling primed/painted steel.
  2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- E. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- G. Sealer: If required, a transparent-drying, water-dispersible, tinted protective coating as recommended by fireproofing manufacturer.
  - 1. Product: Subject to compliance with requirements, provide CAFCO® BOND-SEAL (ISOLATEK® Type EBS) or CAFCO® BOND-SEAL Type X (ISOLATEK® Type X) by ISOLATEK International.
- H. Topcoat: If required, a topcoat suitable for application over applied fireproofing; of type recommended by fireproofing manufacturer.
  - 1. Cement-Based Topcoat: Factory-mixed, cementitious hard-coat formulation for trowel or spray application over SFRM.
    - a. Product: Subject to compliance with requirements, provide CAFCO® FENDOLITE® M-II (ISOLATEK® Type M-II), CAFCO® FENDOLITE® TG (ISOLATEK® Type TG) by ISOLATEK International.
  - 2. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate of [30 sq. ft./gal. (0.75 sq. m/L)] [60 sq. ft./gal. (1.5 sq. m/L)] [120 sq. ft./gal. (3 sq. m/L)].
    - a. Product: Subject to compliance with requirements, provide CAFCO® TOP-COTE (ISOLATEK® Type TOP-COTE) by ISOLATEK International.

## 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 the Work and according to each fire-resistance design. Verify compliance with the following:
  - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other

- foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed by others prior to the application of the fireproofing materials.
  3. The installation of ducts, piping, conduit or other suspended equipment shall not take place until the application of the fireproofing is complete in an area.
- B. Fire protection shall not be applied to steel floor decks prior to the completion of concrete work on that deck.
- C. The application of fireproofing to the underside of roof deck shall not commence until the roof is completely installed and tight, all penthouses are complete, all mechanical units have been placed, and construction roof traffic has ceased. When roof traffic is anticipated, as in the case of periodic maintenance, roofing pavers shall be installed as a walkway to distribute loads.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. 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 fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### 3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.

2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
  2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
  3. When roof traffic is anticipated, as in the case of periodic maintenance, roofing pavers shall be installed as a walkway to distribute loads.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing 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 fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
  2. Spray-Textured Finish: Finish left as spray-applied with no further treatment.
  3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  1. Test and inspect as required by Chapter 17 of the IBC.
  2. For reference, utilize AWCI - Inspection Procedure for Field-Applied Sprayed Fire-Resistive Materials, Technical Manual 12-A; an annotated guide.
- B. Test and inspect completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Application will be considered defective if it does not pass tests and inspections.
  1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
  2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### 3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

END OF SECTION 078100



## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."
      - 3) FM Global in its "Building Materials Approval Guide."

#### 2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction

penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Products: Subject to compliance with requirements, provide penetration firestopping systems that are produced by one of the following manufacturers:
  - a. A/D Fire Protection Systems Inc.
  - b. Grace Construction Products.
  - c. Hilti, Inc.
  - d. Johns Manville.
  - e. Nelson Firestop Products.
  - f. NUCO Inc.
  - g. Passive Fire Protection Partners.
  - h. RectorSeal Corporation.
  - i. Specified Technologies Inc.
  - j. 3M Fire Protection Products.
  - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
  - l. USG Corporation.
  - m. Substitutions: See Section 012500 - Product Requirements.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming 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.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
  1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.2 FIELD QUALITY CONTROL

- A. Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section and following applications:
  - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Control and expansion joints in unit masonry and stone cladding.
    - b. Joints between different materials.
    - c. Perimeter joints between materials and frames of doors, windows and louvers.
    - d. Other joints as indicated.
  - 2. Exterior joints in the following horizontal traffic surfaces:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Other joints as indicated.
  - 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. Tile control and expansion joints.
    - d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
    - e. Vertical joints on exposed surfaces of interior ceramic tile.
    - f. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - h. Other joints as indicated.
  - 4. Interior joints in the following horizontal traffic surfaces:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Joints in tile flooring.
    - c. Other joints as indicated.
- B. See Division 8 Section "Glazing" for glazing sealants.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

#### 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

#### 1.4 QUALITY ASSURANCE

- A. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

#### 1.5 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: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric 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: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

#### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

#### 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

- E. Low-Modulus Neutral -Curing Polyurethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Available Products:
    - a. Pecora Corporation; Dynatrol I-XL.
    - b. Tremco; DyMonic.
    - c. Tremco; Vulkem 921.
    - d. Substitutions: See Section 012500 - Product Requirements.
  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, G, A, and, as applicable to joint substrates indicated, O.
    - a. Coated glass, aluminum coated with a high-performance coating, color anodic aluminum, galvanized steel, brick, limestone, marble, granite, plastic, tile, wood.
- F. Single-Component Mildew-Resistant Acid-Curing 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. Available Products:
    - a. Dow Corning Corporation; 786 Mildew Resistant.
    - b. GE Silicones; Sanitary SCS1700.
    - c. Tremco; Tremsil 200 White.
    - d. Substitutions: See Section 012500 - Product Requirements.
  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. Coated glass, aluminum coated with a high-performance coating, color anodic aluminum, galvanized steel, marble, granite, plastic and tile.
- G. Single-Component Pourable Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Available Products:
    - a. Pecora Corporation; Urexpan NR-201.
    - b. Polymeric Systems Inc.; Flexiprene 952.
    - c. Tremco; Tremflex S/L.
    - d. Tremco; Vulkem 45.
    - e. Sonneborn Building Products, Div., ChemRex Inc.; SL 1.
    - f. Substitutions: See Section 012500 - Product Requirements.
  2. Type and Grade: S (single component) and P (pourable).
  3. Class: 25.
  4. Use 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. Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, granite, marble, ceramic tile and wood.

## 2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.
- B. Available Products:

1. Pecora Corporation; AC-20+.
2. Sonneborn, Division of ChemRex Inc.; Sonolac.
3. Tremco; Tremflex 834.
4. Substitutions: See Section 012500 - Product Requirements.

## 2.5 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 fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (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 to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning

- operations above by vacuuming or blowing out joints with oil-free compressed air.
- 2. Remove laitance and form-release agents from concrete.
  - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- 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.

### 3.2 INSTALLATION

- A. General: All dissimilar materials are to be caulked.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. 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 sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- H. Arrange with manufacturer's rep to conduct a pull test in field to determine adhesion of the sealant to substrate conditions found.



### 3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior horizontal nontraffic and traffic, isolation and contraction joints in cast-in-place concrete slabs.
  - 1. Joint Sealant: Single-component pourable urethane sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry and stone cladding.
  - 1. Joint Sealant: Low- Modulus Neutral-Curing Polyurethane Sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- C. Joint-Sealant Application: Exterior vertical and horizontal joints between different materials.
  - 1. Joint Sealant: Low- Modulus **N**eutral-Curing Polyurethane Sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- D. Joint-Sealant Application: Exterior perimeter joints between masonry and frames of doors and windows.
  - 1. Joint Sealant: Low- Modulus **N**eutral-Curing Polyurethane Sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- E. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- F. Joint-Sealant Application: Interior perimeter joints of exterior openings.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- G. Joint-Sealant Application: Interior ceramic tile joints in horizontal traffic surfaces.
  - 1. Joint Sealant: Single-component, neutral curing, 100% silicone sealant. Same manufacturer as ceramic tile grout manufacturer.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range to match grout color.
- H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
  - 1. Joint Sealant: Single-component mildew-resistant acid-curing silicone sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- I. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturers full color range.
- J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
  - 1. Joint Sealant: Latex sealant.
  - 2. Joint-Sealant Color: As selected by Architect from Manufacturer's full color range.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hollow metal doors and frames.

#### 1.2 SUBMITTALS

- A. Product Data: For each product indicated. Include door designation, type, level and model, material description, label compliance, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Door Schedule. Use same reference designations indicated on Drawings.

#### 1.3 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI A 250.8 unless more stringent requirements are indicated.
- B. Fire-Rated Door 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 252.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group Company.
  - 3. Curries Company; an Assa Abloy Group Company.
  - 4. Mesker Door, Inc.
  - 5. Pioneer Industries Inc.
  - 6. Republic Doors and Frames.
  - 7. Steelcraft; an Ingersoll-Rand Company.
  - 8. Substitutions: See Section 012500 - Product Requirements.

#### 2.2 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
- C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

#### 2.3 DOORS

- A. Interior Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level indicated.
  - 1. Interior Doors (Extra-Heavy-Duty Doors) Level 3 and Physical Performance Level A, Model 1 (Full Flush) 0.053-inch-thick (16 gage).

## 2.4 FRAMES

- A. General: ANSI A250.8; conceal fastenings, unless otherwise indicated.
- B. Frame Steel Sheet Thickness:
  - 1. Interior Frames of minimum 0.053-inch-thick (16 gage) for level 3 steel doors and wood doors.
- C. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
- D. Construction: Full profile welded.
- E. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.
- F. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- G. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be built into exterior walls according to ASTM A 153/A 153M, Class C or D as applicable.
- H. Grout: Where required in masonry construction, as specified in Division 4 "Unit Masonry."

## 2.5 FABRICATION

- A. General: Fabricate steel door and frame units to comply with ANSI A250.8 free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.
- B. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from cold-rolled steel sheet.
- C. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
- D. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.
- E. Clearances for Fire-Rated Doors: As required by NFPA 80.
- F. Door-Edge Profile: Square edge unless beveled edge is indicated.
- G. Tolerances: Comply with SDI 117.
- H. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
- I. Frame Construction:
  - 1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints. Provide temporary spreader bars.
  - 2. Provide terminated stops, where indicated.
- J. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- K. Locate hardware as indicated or, if not indicated, according to ANSI A250.8.
- L. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- (0.8-mm-) thick steel sheet.
  - 1. Provide nonremovable stops on secure side of interior doors for glass, louvers, and other panels in doors.
  - 2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

- M. Astragals: As required by NFPA 80 to provide fire ratings indicated.
- N. Where hollow metal frames are to be inserted into the fire rated steel frame the width of the hollow metal frame shall match the width of the fire rated steel frame.
- O. Coordinate with the fire rated steel frame manufacturer to insure that the total assembly meets the specified fire rating for the entire opening.

## 2.6 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
  - 1. Wall Anchors: Provide at least three anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
  - 2. Fire-Rated Frames: Install according to NFPA 80.
- B. Door Installation: Comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
  - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
  - 2. Smoke Control Doors: Install to comply with NFPA 105.
- C. Prime Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- D. After installation, remove protective wrappings from doors and frames and touch up prime coat with compatible air-drying primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Solid-core doors with wood veneer faces.
  - 2. Factory finishing flush wood doors.
  - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of door. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details; location and extent of hardware blocking; mortises, holes, and cutouts; requirements for veneer matching; factory finishing; fire ratings; and other pertinent data.
- C. Samples: For each face material and finish.
  - 1. Provide samples of custom stain color for Architects approval.

1.3 QUALITY ASSURANCE

- A. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- B. Fire-Rated Wood Doors: Doors that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.5 WARRANTY

- A. General Warranty: Door manufacturer's 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. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not comply with tolerances in referenced quality standard.
  - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 2. Warranty shall be in effect during the following period of time after the date of Substantial Completion:
    - a. Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
  2. Eggers Industries.
  3. Graham; an Assa Abloy Group company.
  4. Marshfield Door Systems, Inc.
  5. Mohawk Flush Doors, Inc.
  6. Oshkosh Door Company.
  7. VT Industries, Inc.
  8. Substitutions: See Section 012500 - Product Requirements.

### 2.2 DOOR CONSTRUCTION

- A. Doors for Transparent Finish:
1. Grade: Premium, with Grade A faces.
  2. Species and Cut: Plain sliced White Birch.
  3. Match between Veneer Leaves: Book match.
  4. Assembly of Veneer Leaves on Door Faces: Center balance match.
  5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  6. Stiles: Applied wood edges of same species as faces applied before veneering faces.
- B. Interior Veneer-Faced Solid-Core Doors:
1. Core: Particleboard.
  2. Construction: Five plies with cross-band, 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.
  2. Edge Construction: Intumescent seals concealed by outer stile matching face veneer, and laminated backing for improved screw-holding capability and split resistance.
  3. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.
- D. Blocking: For mineral-core doors, provide blocking as needed to eliminate through-bolting hardware. For mineral-core doors use composite blocking with improved screw-holding capability.
- E. Provide doors with either glued-block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.

### 2.3 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory machine doors for hardware that is not surface applied.
1. Comply with requirements in NFPA 80 for fire-rated doors.
  2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
- D. Provide pre-machine metal overlapping astragals to inactive door leaf and at double egress door as required. Refer to Division 8 Section "Door Hardware."

## 2.4 FACTORY FINISHING

- A. General: Finish wood doors at factory.
- B. Grade: Premium.
- C. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
- D. Staining: To be selected by Architect from Manufacturer's full range.
- E. Effect: Open-grain finish.
- F. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; 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. Comply with NFPA 80 for fire-rated doors.
- C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- D. Hardware: For installation, see Division 8 Section "Door Hardware."

### 3.2 ADJUSTING AND PROTECTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 081416

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Storefront framing.
  - 2. Manual-swing entrance doors.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  - 2. Include point-to-point wiring diagrams.
- C. Samples: For each type of exposed finish required.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication, and assembly of entrance door hardware, as well as procedures and diagrams.
- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.



## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: per Michigan Building Code.
  - 2. Other Design Loads: per Michigan Building Code.
- D. Deflection of Framing Members: At design wind pressure, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of 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 (19.1 mm), whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
    - 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, as follows:
    - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test according to ASTM E 330/E 330M as follows:
  - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence

- material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
  2. Entrance Doors:
    - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
  2. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 STOREFRONT SYSTEMS

- A. Basis-of-Design Product for Aluminum-Framed Entrances and Storefronts: Subject to compliance with requirements, provide Tubelite E14000 series for interior, and Tubelite T14000 series for exterior. Substitutions: See Section 012500 - Product Requirements.
- B.
- C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken.
  2. Interior Vestibule Framing Construction: Nonthermal.
  3. Glazing System: Retained mechanically with gaskets on four sides.
  4. Finish: Clear anodic finish and baked-enamel.
  5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

## 2.3 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.

## 2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

## 2.5 GLAZING

- A. Glazing: Comply with Section 088000 "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.

## 2.6 MATERIALS

- A. Sheet and Plate: ASTM B 209 (ASTM B 209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
  1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
  4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to the greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from interior.
  6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units' level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight 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.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Test Area: A minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems.
  2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
  3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Aluminum Sunshades and accessories.

### 1.2 RELATED PRODUCTS

- A. Single Manufacture: All products in divisions listed below shall be supplied by a single manufacturer. To ensure consistency in quality, warranty, finish, and product compatibility, products supplied by different manufacturers are not acceptable.
  - a. Section 08 41 13 - Aluminum Framed Entrances and Storefronts

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Pre-installation Meeting:
  - 1. Attendees:
    - a. Owner
    - b. Architect
    - c. General Contractor
    - d. Installer

### 1.4 PERFORMANCE REQUIREMENTS

- A. Design Wind Loads
  - 1. Provide aluminum sunshade system, including but not limited to anchorage capable of withstanding wind load design pressures based on the following:
    - a. Basic Wind Speed of 107 mph
      - i. Importance factor (1)
    - b. Local building codes
    - c. The design snow load for the project will be 35 psf acting vertically downward. Apply drift factor per applicable code.
    - d. Ice loads shall be based on ASCE 7 for the project location.
- B. Structural Performance Requirements
  - 1. Sunshades shall be designed to withstand specified design loads without damage, disengagement, or permanent deformation.
  - 2. Assemblies shall be capable of supporting a concentrated load of 200 lbf at any point without damage, permanent deformation, or disengagement of any component.

### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit for each component within assembly, including material descriptions, component profiles, finishes, anchorage and fasteners, glazing, and internal drainage.
- C. Shop Drawings: Submit system dimensions, tolerances, anchorage, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Include scaled shop drawings showing detailed relationships with adjacent products, anchorage, joinery, and provisions for thermal expansion.
- E. Design Data: Submit framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

- F. Samples: Submit two aluminum sheet stock samples 2 inch x 3 inch long illustrating aluminum surface finish as indicated.
- G. Warranty: Submit manufacturer sample warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least twenty years of experience.
- B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State that the Project is located.
- C. Installer: Company specializing in performing work of this section and approved by manufacturer with at least ten years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle aluminum products of this section in accordance with AAMA CW-10.
- B. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before fabrication of curtain wall framing and indicate measurements on Shop Drawings.
  - 1. Coordinate with construction schedule.
- C. Install sealant according to sealant manufacturer guidelines.

1.9 WARRANTY

- A. Aluminum Sunshade Framing Warranty:
  - 1. Manufacturer agrees to repair or replace defective sunshade components for a period of 2 years from the date of shipment.
- B. Finish Warranty:
  - 1. Warranty covers factory-applied organic and anodic finishes on exposed extruded aluminum surfaces without standing water accumulation, against peeling, checking, cracking, chalking and change of color, per applicable AAMA specifications.
    - a. Paint Coatings
      - i. AAMA 2605 70% PVDF: 10 years
      - ii. AAMA 2604 50% PVDF: 5 years
      - iii. AAMA 2603 Baked Enamel: 1 year (adhesion only)
    - b. Anodized Coatings
      - i. AAMA 611 Class I: 5 years
      - ii. AAMA 611 Class II: 2 years

## PART 2 - PRODUCTS

### 1.10 MANUFACTURER

- A. Basis of Design - Aluminum Sunshades
  - 1. Tubelite Inc. Maxblock® Sunshades Z Blade
  - 2. Substitutions
    - a. Manufacturer's products that meet specified design requirements may be considered as a substitution. Substitution requirements refer to section 012500.

### 1.11 ALUMINUM SUNSHADES

- A. Aluminum sunshades: Shop or field fabricated, factory finished aluminum screw-spline framing members, and related flashing, anchorage and attachment devices.
  - 1. Outrigger projection:
    - a. Z Blade: 24" 4 blades

### 1.12 FINISHES

- A. Finish all exposed areas of aluminum sunshade components in accordance with applicable AAMA Voluntary Finish Guide Specification:

| SPECIFICATION | DESCRIPTION  | DESIGNATION  | COLOR |
|---------------|--|--------------|-------|
| AAMA 611      | Class I - Clear anodize coating,<br>Eco-friendly etch (0.7 mils thick min) | AA-M10C21A41 | Clear |

- A. Combination anodic oxide and transparent organic coatings as defined in AAMA 612 are not equivalent substitutions for the AAMA 611 anodized finishes shown above due to surface hardness disparities.
- B. Applicator Qualifications: Certified by AAMA and listed on AAMA Verified Components List.
- C. Verify accuracy of components, quantities, and sizes prior to application of finishes.
- D. Applicator - Anodize Finishes
  - a. Offer both standard eco-friendly (acid) and optional caustic (traditional) etching technologies.
  - b. Utilize fully automated, computer-controlled process lines for consistency through Project.
  - c. Utilize documented quality control protocol in accordance with AAMA 611 procedures.
    - i. Online quality assurance inspection:
      - 1. Random sample check for color uniformity, maximum difference of 5AE.
      - 2. Random coating thickness testing:
        - a. Class I clear and color anodize - 0.7 mils (18 microns)

### 1.13 MATERIALS

- A. Extruded Aluminum: Alloy 6063-T6 in accordance with ASTM B221, and extruded within commercial tolerances and free from defects that impair strength and/or durability.
- B. Optional Recycled Content: For aluminum extrusions, except those required for doors and door frames, provide manufacturer's product fabricated from aluminum with 70 percent or greater recycled content.
  - a. Product: EcoLuminum™ by Tubelite Inc.
- C. Structural Steel Sections: ASTM A36/A36M; Refer to Section 05 1200.



- a. Where galvanizing is not compatible with alloy of component parts, apply heavy coating of epoxy paint where necessary to prevent galvanic action with dissimilar materials.
- D. Structural Supporting Anchors: Refer to Section 05 12 00.
- E. Fasteners: Stainless steel.
- F. Inserts: Provide galvanized steel or cast iron inserts of suitable design and adequate strength for condition of use.
- G. Galvanizing Repair Paint: High zinc content paint for over welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight and in compliance with SSPC Paint 20.
- H. Bituminous Paint: Cold applied asphalt mastic, containing no asbestos fibers.

## 2.12 FABRICATION

- A. Ensure joints and corners are flush, hairline and weatherproof, accurately fitted and secured.
  - 1. Prepare framework to receive anchors and hardware.
  - 2. Conceal fasteners and attachments from view.
  - 3. Reinforce framework as required for imposed loads.
- B. Construction: Eliminate noises caused by wind and thermal movement, and prevent vibration harmonics.
- C. Movement: Allow for movement between curtain wall and adjacent construction, without damage to components.
- D. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

## PART 3 - EXECUTION

### 3.1 VERIFICATION OF CONDITIONS

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of this Work.
- B. Notify Contractor in writing, with a copy sent to Owner and Architect, of any conditions detrimental to proper and timely completion of this Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate and furnish anchors, concrete inserts, sleeves, anchor bolts, and other accessories to be embedded in concrete or masonry construction.
  - 1. Coordinate delivery of these items to Project site.

### 3.3 INSTALLATION

- A. Install aluminum sunshade assemblies in accordance with manufacturer's installation instructions, reviewed product data, approved shop drawings, and as indicated on Drawings (per Professional Engineer review when applicable).
- B. Do not install damaged components.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, [aligning with adjacent work].
- F. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

- G. Install accessories with positive anchorage to building, weather tight mounting, provisions for thermal expansion, and coordinate installation with flashings and other components.
- H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

#### 3.4 TOLERANCES

- A. Maximum Variation from Plumb: [0.06 inches] per 10 ft, whichever is least.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

#### 3.5 CLEANING

- A. Comply with AAMA 609 and 610 for methods, equipment, and materials to clean finished aluminum after installation and for subsequent periodic maintenance.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners, and wipe surfaces clean.
- C. Remove excess sealant from glass and aluminum by method acceptable to sealant and finish manufacturer.

#### 3.6 PROTECTION

- A. Protect installed products from damage during subsequent construction.
- B. Protect anodized finishes from prolonged exposure to alkaline, such as lime in masonry mortar, or acidic and other corrosive materials.

END OF SECTION 08 44 13

## PART 1 - GENERAL

- 1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.
- 1.2 Work Included:
- A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
  - B. Related work:
    - 1. Division 00 00 00 – Procurement and Contracting Requirements
    - 2. Division 01 00 00 – General Requirements
    - 3. Division 06 00 00 – Wood, Plastics, and Composites
    - 4. Division 08 00 00 – Openings
    - 5. Division 10 00 00 – Specialties
    - 6. Division 11 00 00 – Equipment
    - 7. Division 26 00 00 – Electrical
    - 8. Division 27 00 00 – Communications
    - 9. Division 28 00 00 – Electronic Safety and Security
  - C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
    - 1. Cabinet Hardware.
    - 2. Signs, except as noted.
    - 3. Folding partitions, except cylinders where detailed.
    - 4. Sliding aluminum doors
    - 5. Chain link and wire mesh doors and gates
    - 6. Access doors and panels
    - 7. Overhead and Coiling doors
- 1.3 Quality Assurance
- A. Requirements of Regulatory Agencies:
    - 1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
    - 2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
    - 3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.
  - B. Hardware Supplier:

1. Shall be an established firm dealing in contract builders' hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant (AHC).

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
2. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-installation Meeting:

1. Before hardware installation, General Contractor/Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
3. Convene one week or more prior to commencing work of this Section.
4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.
3. Schedule will include the following:
  - a. Door Index including opening numbers and the assigned Finish Hardware set.
  - b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

|          |           |           |
|----------|-----------|-----------|
| CATEGORY | SPECIFIED | SCHEDULED |
|----------|-----------|-----------|

|             |                |                |
|-------------|----------------|----------------|
| Hinges      | Manufacturer A | Manufacturer B |
| Lock sets   | Manufacturer X | Manufacturer X |
| Kick Plates | Open           | Manufacturer Z |

- c. Hardware Locations: Refer to Article 3.1 B.2 Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
- e. Hardware Description: Quantity, category, product number, fasteners, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. Scheduling Sequence shown in Hardware Sets.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. Electrified Hardware system operation description.
- j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
- k. Typed Copy.
- l. Double-Spacing.
- m. 8-1/2 x 11 inch sheets
- n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:

- 1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
- 2. Submit product data with hardware schedule.

C. Samples:

- 1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
- 2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Key Schedule:

- 1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
- 2. Submit as a separate schedule.

E. Electrified Hardware Drawings:

- 1. Submit elevation drawings showing relationship of all electrical hardware components to door and frame. Indicate number and gage of wires required.
  - a. Include wiring drawing showing point to point wire hook up for all components.
  - b. Include system operations descriptions for each type of opening; describe each possible condition.

F. Submit to General Contractor/Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.

## 1.5 Product Delivery, Storage, and Handling:

- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.

## 1.6 Existing Conditions:

- A. **Where existing doors, frames and/or hardware are to remain, conditions, preparations and functions shall be field verified to confirm compatibility with specified hardware. Where any incompatibility is discovered, notify the contractor or construction manager immediately and provide a suggested solution based on industry standard business practices.**

## 1.7 Warranties:

- A. Refer to Division 1 for warranty requirements.
- B. Special Warranty Periods:
  - 1. Closers shall carry manufacturer's 30-year warranty against manufacturing defects and workmanship.
  - 2. Locksets shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
  - 3. Exit Devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
  - 4. Continuous gear hinges shall carry manufacturer's lifetime warranty to be free from defects in material and workmanship.
  - 5. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
- C. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work.

## PART 2 - PRODUCT

- 2.1 Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.

- 2.2 Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, it is understood that this is the owner's Building Standard and "no substitution" is allowed.

- A. Hinges:

- 1. Furnish hinges of class and size as listed in sets.
  - 2. Numbers used are Ives (IVE).
  - 3. Products of a BHMA member are acceptable.

- B. Continuous Gear Hinge:

1. 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pinless assembly, three interlocking extrusions, full height of door and frame, fasteners 410 stainless steel plated and hardened. Anodizing of material shall be done after fabrication of components so that all bearing slots are anodized.
2. Length: 1" less than door opening height. Fastener 12-24 x 1/2" #3 Phillips keen form stainless steel self-tapping at aluminum and hollow metal doors, 12- 1/2" #3 Philips, flathead full thread at wood doors.
3. Furnish fire rated hinges "FR" at labeled openings.
4. Numbers used are Ives.
  - a. For Hollow Metal frames;
    - 1) Ives 224XY
    - 2) Equal products by Pemko & Select will also be accepted.
  - b. For Aluminum frames;
    - 1) Ives 112XY
    - 2) Equal products by Pemko & Select will also be accepted.

C. Locksets and Latchsets – Cylindrical Grade 1:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairl.
3. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
4. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag t.
5. Function numbers are Schlage.
  - a. Schlage ND Series
6. Lockset Trim:
  - a. Schlage Rhodes
7. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond door frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

D. Locksets and Latchsets - Mortise Type:

1. Locksets shall be manufactured from heavy gauge steel, minimum lockcase thickness 1/8", containing components of steel with a zinc dichromate plating for corrosion resistance.
2. Locks are to have a standard 2 3/4" backset with a full 3/4" throw two-piece stainless steel mechanical anti-friction latchbolt. Deadbolt shall be a full 1" throw, constructed of stainless steel.
3. Lockcase shall be easily handed without chassis disassembly by removing handing screw on lockcase and installing in opposite location on reverse side. Changing of door hand bevel from standard to reverse hand shall be done by removing the lockcase scalp plate, and pulling and rotating the latchbolt 180 degrees.
4. Lock trim shall be through-bolted to the door to assure correct alignment and proper operation. Lever trim shall have external spring cage mechanism to assist in support of the lever weight.
5. Function numbers are Schlage.
  - a. Schlage L9000
6. Lockset Trim:
  - a. Schlage 06B
7. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond door frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

8. Provide strikes as required to match existing conditions and preparations at existing openings.

E. Exit Devices:

1. Exit devices shall be touchpad style, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.
2. All exit devices shall incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width. All latchbolts to be deadlatching type, with a self-lubricating coating to reduce wear.
3. End-cap will be sloped to deflect any impact from carts and they shall be flush with the external mechanism case. End caps that overlap and project above the mechanism case are unacceptable. End cap shall utilize a two-point attachment to the mounting bracket.
4. Touchpad shall match exit device finish, and shall be stainless steel for US26, US26D, US28, US32, and US32D finishes. Only compression springs will be used in devices, latches, and outside trims or controls.
5. Plastic templates shall be included with each exit device to facilitate a quick, easy and accurate installation.
6. Strikes shall be roller type and come complete with a locking plate to prevent movement.
7. All rim and vertical rod exit devices shall have passed a 5 million(5,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
8. All mortise exit devices shall have passed a 10 million(10,000,000)cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
9. Provide cylinder dogging on panic exit hardware where noted in hardware sets.
10. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.
11. Lever trim for exit devices shall be vandal-resistant type, which will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
12. Von Duprin 98 Series. Series and function numbers as listed in sets.
13. Trim:
  - a. As specified in sets.
  - b. Levers to match lockset design where specified.

F. Electric Strike:

1. Electric strikes shall provide remote release of latchbolts. They shall be designed for use with the type locks shown at each opening where required. Strikes will be UL Listed for Burglary-Resistant Electric Door Strike, and where required, shall be UL listed as electric strikes for Fire Doors or Frames. Faceplates shall be stainless steel with finish as specified for each opening. The locking components shall be stainless steel to resist damage and abuse.
2. Solenoids shall be of the continuous duty type for the voltage specified. Plug connectors will be furnished. Strikes shall have an adjustable backbox to compensate for misalignment of door and frame.
3. Numbers used in sets are Von Duprin.
  - a. Von Duprin 6000 series

G. Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1 1/2" in diameter, and double heat treated pinion shall be 11/16" in diameter with double D slab drive arm connection.



2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
5. All surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory.
6. Closers will have Powder coating finish certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.
7. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
8. LCN Series as listed in sets.

#### H. Automatic Door Operators

1. Where "Low Energy Power Operated Door" as defined by ANSI Standard A156.19, is indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA requirements for opening force and time to close standards.
2. Full closing force shall be provided when the power or assist cycle ends.
3. Modular design, adjustments easily accessible from the front, UL listed for use on labeled doors.
4. Shall have "Second Chance" function to accommodate momentary resistance, "Breakaway" function in the electronically controlled clutch, "Soft Start" motor control function and "Maintain hold-open switch" to hold the door open at 90 deg.
5. Shall have built in 12V and 24V power supply for actuators, card readers, electric strikes and magnetic door locks, inputs for both swing and stop side sensors and available to accept either 120VAC or 220VAC input power. All wiring connections between operator modules made by easy-to-handle electrical connectors. Shall comply with both UL and NEC requirements for Class 1 and Class 2 wiring by providing separate conduits for each.
6. Shall have seven independent electronic adjustments to tailor the operator for specific site conditions. Opening speed, holding force at 90 deg., sequential trigger and time delay, hold-open time at 90 deg., opening force, clutch "breakaway" force setting, electric strike trigger and time delay.
7. Shall have separate and independent adjustments for back check, main speed and latch speed.
8. Furnish actuators and other controls as shown in Hardware sets.
9. Sizes as specified in Hardware Sets. Provide concealed wiring connections.

- a. Surface Mounted: LCN 4640 Auto-Equalizer Series.

#### I. Overhead Holders and Stops:

1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
  - a. Glynn-Johnson

## J. Kick Plates:

1. Furnish .050 inches thick, beveled four sides, countersunk fasteners, 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
2. Any BHMA manufacturing product meeting above is acceptable.

## K. Bumpers:

1. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.
  - a. Ives WS406/WS407 series
  - b. BHMA L02101.

## L. Wall Stops:

1. Length to exceed projection of all other hardware. Provide with threaded studs and expansion shields for masonry wall construction. **Install with slope at top.**
  - a. Ives WS33(X)
  - b. BHMA L12011 or L12021

## M. Thresholds:

1. 1/4" high - 6" wide. Cope at jambs.
2. Furnish full wall opening width when frames are recessed.
3. Cope in front of mullions if thresholds project beyond door faces.
4. Furnish with non-ferrous Stainless Steel Screws and Lead Anchors.
  - a. Zero as listed in sets
  - b. Equal of NGP or Reese

## N. Door Sweeps:

1. Surface Sweeps:
  - a. Zero as listed in sets
  - b. Equal of NGP or Reese

## O. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

## P. Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.
2. **Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.**

## 2.3 Finishes:

- A. Generally, Dull Chrome, US26D / BHMA 626. Provide finish for each item as indicated in sets.

#### 2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

#### 2.5 Cylinders and Keying:

- A. All cylinders for this project will be supplied by one supplier regardless of door type and location.
- B. The Finish Hardware supplier will meet with Architect and/or Owner to finalize keying requirements and obtain keying instructions in writing.
  - 1. Supplier shall include the cost of this service in his proposal.
- C. Provide a cylinder for all hardware components capable of being locked.
- D. Provide cylinders master and grand master keyed to existing Schlage system according to Owner's instructions. Provide change keys, master keys and grand master keys as required by Owner.

### PART 3 - EXECUTION

#### 3.1 Installation

##### A. General:

1. Install hardware according to manufacturers installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
2. **Provide blocking/reinforcement for all wall mounted Hardware.**
3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.
4. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
5. Continuous gear hinges attached to hollow metal doors and frames and aluminum doors and frames: 12-24 x 1/2" #3 Phillips Keenform self-tapping. Use #13 or 3/16 drill for pilot.
6. Continuous Gear Hinges require continuous mortar guards of foam or cardboard 1/2" thick x frame height, applied with construction adhesive.
7. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

##### B. Locations:

1. Dimensions are from finish floor to center line of items.

2. Include this list in Hardware Schedule.

CATEGORYDIMENSION

Hinges

Door Manufacturer's Standard

Levers

Door Manufacturer's Standard

Exit Device Touchbar

Per Template

Wall Stops/Holders

At Head

## C. Field Quality Inspection:

1. Inspect material furnished, its installation and adjustment, and instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets and exit devices shall be inspected after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
3. Closers shall be inspected and adjusted after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
4. A written report stating compliance, and also locations and kinds of noncompliance shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner.






## D. Technical and Warranty Information:

1. At the completion of the project, the technical and warranty information coalesced and kept on file by the General Contractor/Construction Manager shall be given to the Owner or Owner's Agent. In addition to both the technical and warranty information, all factory order acknowledgement numbers supplied to the General Contractor/Construction Manager during the construction period shall be given to the Owner or Owner's Agent. The warranty information and factory order acknowledgement numbers shall serve to both expedite and properly execute any warranty work that may be required on the various hardware items supplied on the project.
2. Submit to General Contractor/Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

## 3.2 Hardware Sets:






**Hardware Group No. 01**

## EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4111 EDA MC                 |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |
| 1   | EA | WALL STOP         | WS406/407CVX                |  | 630    | IVE |






**Hardware Group No. 02**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP     |  | 652    | IVE |
| 1   | EA | STOREROOM LOCK | ND80P6D RHO            |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4011 MC                |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CVX           |  | 630    | IVE |

**Hardware Group No. 03**




EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4111 EDA MC                 |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |
| 1   | EA | WALL STOP         | WS33                        |  | 626    | IVE |

MOUNT STOP ON DOOR.






**Hardware Group No. 04**

EACH TO HAVE:

| QTY |    | DESCRIPTION          | CATALOG NUMBER     |   | FINISH | MFR |
|-----|----|----------------------|--------------------|---|--------|-----|
| 3   | EA | HINGE                | 5BB1 4.5 X 4.5 NRP |    | 652    | IVE |
| 1   | EA | ENTRANCE/OFFICE LOCK | ND50P6D RHO        |    | 626    | SCH |
| 1   | EA | WALL STOP            | WS406/407CCV       |  | 630    | IVE |




**Hardware Group No. 05**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP     |  | 652    | IVE |
| 1   | EA | CLASSROOM LOCK | ND70P6D RHO            |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4011 MC                |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CVX           |  | 630    | IVE |











**Hardware Group No. 06**

EACH TO HAVE:

| QTY |    | DESCRIPTION   | CATALOG NUMBER    |   | FINISH | MFR |
|-----|----|---------------|-------------------|---|--------|-----|
| 3   | EA | HINGE         | 5BB1 HT 4.5 X 4.5 |  | 652    | IVE |
| 1   | EA | TIME OUT LOCK | ND45 RHO XN12-317 |  | 626    | SCH |
| 1   | EA | WALL STOP     | WS406/407CVX      |  | 630    | IVE |








**Hardware Group No. 07**

EACH TO HAVE:

| QTY |     | DESCRIPTION         | CATALOG NUMBER                 |   | FINISH | MFR |
|-----|-----|---------------------|--------------------------------|---|--------|-----|
| 1   | EA  | CONT. HINGE         | 224XY                          |  | 628    | IVE |
| 1   | EA  | PANIC HARDWARE      | CDSI-98-NL-OP-110MD            |  | 626    | VON |
| 1   | EA  | MORTISE CYLINDER    | 20-001                         |  | 626    | SCH |
| 1   | EA  | PRIMUS RIM CYLINDER | 20-757                         |  | 626    | SCH |
| 1   | EA  | DOOR PULL           | VR910 NL                       |  | 630    | IVE |
| 1   | EA  | OH STOP & HOLDER    | 90H                            |  | 630    | GLY |
| 1   | EA  | SURFACE CLOSER      | 4111 EDA MCSRI ST-2730 ST-1631 |  | 689    | LCN |
| 1   | SET | GASKETING           | 429AA                          |  | D      | ZER |
| 1   | EA  | DOOR SWEEP          | 39A                            |  | A      | ZER |
| 1   | EA  | THRESHOLD           | 656A-V3-223                    |  | A      | ZER |







**Hardware Group No. 08**

EACH TO HAVE:

| QTY |    | DESCRIPTION        | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|--------------------|------------------------|---|--------|-----|
| 6   | EA | HINGE              | 5BB1HW 4.5 X 4.5 NRP   |    | 652    | IVE |
| 2   | EA | FIRE EXIT HARDWARE | 9849-L-F-06-LBL        |    | 626    | VON |
| 2   | EA | RIM CYLINDER       | 20-057                 |    | 626    | SCH |
| 1   | EA | OH STOP            | 90S                    |    | 652    | GLY |
| 2   | EA | SURFACE CLOSER     | 4111 EDA MC ST-2730    |    | 689    | LCN |
| 2   | EA | KICK PLATE         | 8400 10" X 1" LDW B-CS |   | 630    | IVE |
| 1   | EA | WALL STOP          | WS33X                  |  | 626    | IVE |






**Hardware Group No. 09**

EACH TO HAVE:

| QTY |    | DESCRIPTION        | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|--------------------|------------------------|---|--------|-----|
| 6   | EA | HINGE              | 5BB1HW 4.5 X 4.5 NRP   |  | 652    | IVE |
| 2   | EA | FIRE EXIT HARDWARE | 9849-EO-F-LBL          |  | 626    | VON |
| 1   | EA | OH STOP            | 90S                    |  | 652    | GLY |
| 2   | EA | SURFACE CLOSER     | 4111 EDA MC ST-2730    |  | 689    | LCN |
| 2   | EA | KICK PLATE         | 8400 10" X 1" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP          | WS33X                  |  | 626    | IVE |

**Hardware Group No. 10**






EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 5 X 4.5 NRP            |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4111 EDA MC                 |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |
| 1   | EA | WALL STOP/HOLDER  | WS40                        |  | 626    | IVE |

REINFORCE DOOR FOR STOP/HOLDER.






**Hardware Group No. 11**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER            |   | FINISH | MFR |
|-----|----|---------------------|---------------------------|---|--------|-----|
| 3   | EA | HINGE               | 5BB1 5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | PRIVACY W/COIN TURN | L9044 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | OH STOP             | 90S                       |  | 652    | GLY |
| 1   | EA | SURFACE CLOSER      | 4011 MC                   |  | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS    |  | 630    | IVE |






**Hardware Group No. 12**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER            |   | FINISH | MFR |
|-----|----|---------------------|---------------------------|---|--------|-----|
| 3   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP        |  | 652    | IVE |
| 1   | EA | PRIVACY W/COIN TURN | L9044 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER      | 4011 MC                   |  | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS    |  | 630    | IVE |
| 1   | EA | WALL STOP           | WS406/407CCV              |  | 630    | IVE |




**Hardware Group No. 13**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER     |   | FINISH | MFR |
|-----|----|---------------------|--------------------|---|--------|-----|
| 1   | EA | SPRING HINGE        | 3SP1 4.5 X 4.5     |    | 630    | IVE |
| 2   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP |    | 630    | IVE |
| 1   | EA | ROLLER LATCH        | RL32               |   | 626    | IVE |
| 1   | EA | OCC. IND.           | D271 X CDS-PR1     |  | 626    | FAL |
| 1   | EA | DOOR PULL, 3/4" RND | PR 8102HD 6" J     |  | 630    | IVE |







**Hardware Group No. 14**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER     |   | FINISH | MFR |
|-----|----|----------------|--------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP |  | 652    | IVE |
| 1   | EA | CLASSROOM LOCK | ND70P6D RHO        |  | 626    | SCH |
| 1   | EA | WALL STOP      | WS406/407CVX       |  | 630    | IVE |





**Hardware Group No. 15**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER     |   | FINISH | MFR |
|-----|----|---------------------|--------------------|---|--------|-----|
| 2   | EA | SPRING HINGE        | 3SP1 4.5 X 4.5     |  | 630    | IVE |
| 1   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP |  | 630    | IVE |
| 1   | EA | ROLLER LATCH        | RL32               |  | 626    | IVE |
| 1   | EA | OCC. IND.           | D271 X CDS-PR1     |  | 626    | FAL |
| 1   | EA | DOOR PULL, 3/4" RND | PR 8102HD 6" J     |  | 630    | IVE |
| 1   | EA | WALL STOP           | WS406/407CVX       |  | 630    | IVE |





**Hardware Group No. 16**

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4111 CUSH MC                |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |












**Hardware Group No. 17**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 5 X 4.5 NRP       |  | 652    | IVE |
| 1   | EA | CLASSROOM LOCK | ND70P6D RHO            |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4111 CUSH MC           |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |

**Hardware Group No. 18**

EACH TO HAVE:

| QTY |     | DESCRIPTION         | CATALOG NUMBER                     |   | FINISH  | MFR |
|-----|-----|---------------------|------------------------------------|---|---------|-----|
| 2   | EA  | CONT. HINGE         | 027XY TWP CON                      |    | 628     | IVE |
| 1   | EA  | ELEC PANIC HARDWARE | LX-QEL-9849-EO-LBL 24 VDC          |    | 626     | VON |
| 1   | EA  | ELEC PANIC HARDWARE | LX-QEL-9849-NL-OP-110MD-LBL 24 VDC |    | 626     | VON |
| 1   | EA  | PRIMUS RIM CYLINDER | 20-757                             |   | 626     | SCH |
| 2   | EA  | 90 DEG OFFSET PULL  | 8190EZHD 12" O                     |  | 630-316 | IVE |
| 2   | EA  | OH STOP             | 100SE                              |  | 630     | GLY |
| 2   | EA  | SURF. AUTO OPERATOR | 4642 WMS 120 VAC                   |  | 689     | LCN |
| 1   | EA  | WEATHER RING        | 8310-801                           |  |         | LCN |
| 2   | EA  | ACTUATOR, TOUCH     | 8310-853T                          |  | 630     | LCN |
| 1   | SET | WEATHER SEAL        | (BY FRAME MFR)                     |   |         |     |
| 2   | EA  | DOOR SWEEP          | 39A                                |  | A       | ZER |
| 1   | EA  | THRESHOLD           | 656A-V3-223                        |  | A       | ZER |
| 1   | EA  | ACCESS CONTROL      | (BY SECURITY CONTRACTOR)           | ⚡   |         |     |
| 1   | EA  | POWER SUPPLY        | (BY SECURITY CONTRACTOR)           |   |         |     |






PRESENTING AN AUTHORIZED CREDENTIAL WILL RETRACT THE PANIC HARDWARE LATCHES AND ENABLE THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW ACCESS. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES,











**Hardware Group No. 19**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER               |   | FINISH | MFR |
|-----|----|----------------|------------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 5 X 4.5 NRP             |  | 652    | IVE |
| 1   | EA | KEYED PRIVACY  | L9456BDC 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4011 MC                      |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS       |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CCV                 |  | 630    | IVE |

**Hardware Group No. 20**

EACH TO HAVE:







| QTY |    | DESCRIPTION         | CATALOG NUMBER                     |   | FINISH  | MFR |
|-----|----|---------------------|------------------------------------|---|---------|-----|
| 2   | EA | CONT. HINGE         | 027XY TWP CON                      |  | ✓ 628   | IVE |
| 1   | EA | ELEC PANIC HARDWARE | LX-QEL-9849-EO-LBL 24 VDC          |  | ✓ 626   | VON |
| 1   | EA | ELEC PANIC HARDWARE | LX-QEL-9849-NL-OP-110MD-LBL 24 VDC |  | ✓ 626   | VON |
| 1   | EA | PRIMUS RIM CYLINDER | 20-757                             |  | 626     | SCH |
| 2   | EA | 90 DEG OFFSET PULL  | 8190EZHD 12" O                     |  | 630-316 | IVE |
| 2   | EA | OH STOP             | 100SE                              |  | 630     | GLY |
| 2   | EA | SURF. AUTO OPERATOR | 4642 WMS 120 VAC                   |  | ✓ 689   | LCN |
| 2   | EA | ACTUATOR, TOUCH     | 8310-853T                          |  | ✓ 630   | LCN |
| 1   | EA | ACCESS CONTROL      | (BY SECURITY CONTRACTOR)           | ✓   |         |     |
| 1   | EA | POWER SUPPLY        | (BY SECURITY CONTRACTOR)           |   |         |     |

PRESENTING AN AUTHORIZED CREDENTIAL WILL RETRACT THE PANIC HARDWARE LATCH AND ENABLE THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW ACCESS. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES,

**Hardware Group No. 21**

EACH TO HAVE:








| QTY |    | DESCRIPTION         | CATALOG NUMBER   |   | FINISH  | MFR |
|-----|----|---------------------|------------------|---|---------|-----|
| 2   | EA | CONT. HINGE         | 027XY            |  | 628     | IVE |
| 2   | EA | PUSH BAR            | 350              |  | 626     | VON |
| 2   | EA | 90 DEG OFFSET PULL  | 8190EZHD 12" O   |  | 630-316 | IVE |
| 2   | EA | OH STOP             | 100SE            |  | 630     | GLY |
| 2   | EA | SURF. AUTO OPERATOR | 4642 WMS 120 VAC |  | ✓ 689   | LCN |
| 2   | EA | ACTUATOR, TOUCH     | 8310-853T        |  | ✓ 630   | LCN |

THE AUTOMATIC OPERATOR ACTUATORS ARE ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES,

**Hardware Group No. 22**

EACH TO HAVE:








| QTY |    | DESCRIPTION         | CATALOG NUMBER                     |   | FINISH | MFR |
|-----|----|---------------------|------------------------------------|---|--------|-----|
| 1   | EA | CONT. HINGE         | 027XY                              |    | 628    | IVE |
| 1   | EA | STOREROOM LOCK      | ND80P6D RHO                        |    | 626    | SCH |
| 1   | EA | ELECTRIC STRIKE     | 6211 FSE DS 12/16/24/28<br>VAC/VDC |  ✎ | 630    | VON |
| 1   | EA | OH STOP             | 100SE                              |    | 630    | GLY |
| 1   | EA | SURF. AUTO OPERATOR | 4642 WMS 120 VAC                   |  ✎ | 689    | LCN |
| 2   | EA | ACTUATOR, TOUCH     | 8310-853T                          |  ✎ | 630    | LCN |
| 1   | EA | ACCESS CONTROL      | (BY SECURITY CONTRACTOR)           | ✎   |        |     |
| 1   | EA | DESK MOUNT BUTTON   | 660-PB                             |  ✎ | 628    | SCE |
| 1   | EA | POWER SUPPLY        | (BY SECURITY CONTRACTOR)           |   |        |     |

PRESSING REMOTE RELEASE BUTTON OR PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE AND ENABLE THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW ACCESS. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES,

**Hardware Group No. 23**

EACH TO HAVE:







| QTY |    | DESCRIPTION         | CATALOG NUMBER                     |   | FINISH | MFR |
|-----|----|---------------------|------------------------------------|---|--------|-----|
| 1   | EA | CONT. HINGE         | 027XY                              |      | 628    | IVE |
| 1   | EA | CLASSROOM/STOREROOM | L9070/80L 06B XL12-876             |     | 626    | SCH |
| 1   | EA | ELECTRIC STRIKE     | 6211 FSE DS 12/16/24/28<br>VAC/VDC |  ✎ | 630    | VON |
| 1   | EA | SURF. AUTO OPERATOR | 4642 WMS 120 VAC                   |  ✎ | 689    | LCN |
| 2   | EA | ACTUATOR, TOUCH     | 8310-853T                          |  ✎ | 630    | LCN |
| 1   | EA | WALL STOP           | WS33X                              |    | 626    | IVE |
| 1   | EA | ACCESS CONTROL      | (BY SECURITY CONTRACTOR)           | ✎   |        |     |
| 1   | EA | DESK MOUNT BUTTON   | 660-PB                             |  ✎ | 628    | SCE |
| 1   | EA | POWER SUPPLY        | (BY SECURITY CONTRACTOR)           |   |        |     |

PRESSING REMOTE RELEASE BUTTON OR PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE AND ENABLE THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW ACCESS. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES,







**Hardware Group No. 24**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP     |  | 652    | IVE |
| 1   | EA | PUSH PLATE     | 8200 4" X 16"          |  | 630    | IVE |
| 1   | EA | PULL PLATE     | 8302 8" 4" X 16"       |  | 630    | IVE |
| 1   | EA | SURFACE CLOSER | 4011 MC                |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS33X                  |  | 626    | IVE |




**Hardware Group No. 25**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP     |  | 652    | IVE |
| 1   | EA | PUSH PLATE     | 8200 4" X 16"          |  | 630    | IVE |
| 1   | EA | PULL PLATE     | 8302 8" 4" X 16"       |  | 630    | IVE |
| 1   | EA | SURFACE CLOSER | 4111 EDA MC            |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS33                   |  | 626    | IVE |






**Hardware Group No. 26**

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | OH STOP           | 450S                        |  | 652    | GLY |







**Hardware Group No. 27**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH  | MFR |
|-----|----|----------------|------------------------|---|---------|-----|
| 6   | EA | HINGE          | 5BB1HW 4.5 X 4.5 NRP   |    | 652     | IVE |
| 2   | EA | PUSH/PULL BAR  | 9103EZHD-12"-NO        |    | 630-316 | IVE |
| 2   | EA | OH STOP        | 90S                    |    | 652     | GLY |
| 2   | EA | SURFACE CLOSER | 4111 EDA MC ST-2730    |  | 689     | LCN |
| 2   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630     | IVE |






**Hardware Group No. 28**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1HW 4.5 X 4.5 NRP   |  | 652    | IVE |
| 1   | EA | PANIC HARDWARE | 98-L-06                |  | 626    | VON |
| 1   | EA | RIM CYLINDER   | 20-057                 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4111 EDA MC            |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS33X                  |  | 626    | IVE |






**Hardware Group No. 29**

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         |   | FINISH | MFR |
|-----|----|----------------|------------------------|---|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP     |  | 652    | IVE |
| 1   | EA | STOREROOM LOCK | ND80P6D RHO            |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4111 EDA MC            |  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS |  | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CVX           |  | 630    | IVE |






**Hardware Group No. 30**

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4011 MC                     |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |
| 1   | EA | WALL STOP         | WS406/407CVX                |  | 630    | IVE |






**Hardware Group No. 31**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER            |   | FINISH | MFR |
|-----|----|---------------------|---------------------------|---|--------|-----|
| 3   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP        |  | 652    | IVE |
| 1   | EA | PRIVACY W/COIN TURN | L9044 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER      | 4111 EDA MC               |  | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS    |  | 630    | IVE |
| 1   | EA | WALL STOP           | WS406/407CCV              |  | 630    | IVE |














**Hardware Group No. 32**

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 5 X 4.5 NRP            |    | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |    | 626    | SCH |
| 1   | EA | OH STOP           | 90S                         |   | 652    | GLY |
| 1   | EA | SURFACE CLOSER    | 4111 EDA MC ST-2730         |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |







**Hardware Group No. 33**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER |   | FINISH  | MFR |
|-----|----|---------------------|----------------|---|---------|-----|
| 2   | EA | CONT. HINGE         | 027XY          |  | 628     | IVE |
| 1   | EA | REMOVABLE MULLION   | KR4954 STAB    |  | 689     | VON |
| 1   | EA | PANIC HARDWARE      | 98-EO          |  | 626     | VON |
| 1   | EA | PANIC HARDWARE      | 98-NL-OP-110MD |  | 626     | VON |
| 1   | EA | MORTISE CYLINDER    | 20-001         |  | 626     | SCH |
| 1   | EA | PRIMUS RIM CYLINDER | 20-757         |  | 626     | SCH |
| 2   | EA | 90 DEG OFFSET PULL  | 8190EZHD 12" O |  | 630-316 | IVE |
| 2   | EA | OH STOP             | 100S           |  | 630     | GLY |
| 2   | EA | SURFACE CLOSER      | 4021 MC        |  | 689     | LCN |
| 2   | EA | MTG PLATE           | 4020-18G       |  | 693     | LCN |
| 1   | EA | MULLION SEAL        | 8780NBK PSA    |  | BK      | ZER |
| 2   | EA | DOOR SWEEP          | 39A            |  | A       | ZER |
| 1   | EA | THRESHOLD           | 656A-V3-223    |  | A       | ZER |






**Hardware Group No. 34**

EACH TO HAVE:

| QTY |    | DESCRIPTION        | CATALOG NUMBER |   | FINISH  | MFR |
|-----|----|--------------------|----------------|---|---------|-----|
| 2   | EA | CONT. HINGE        | 027XY          |  | 628     | IVE |
| 2   | EA | PUSH BAR           | 350            |  | 626     | VON |
| 2   | EA | 90 DEG OFFSET PULL | 8190EZHD 12" O |  | 630-316 | IVE |
| 2   | EA | OH STOP            | 100S           |  | 630     | GLY |
| 2   | EA | SURFACE CLOSER     | 4021 MC        |  | 689     | LCN |
| 2   | EA | MTG PLATE          | 4020-18G       |  | 693     | LCN |

**Hardware Group No. 35**




EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4111 EDA MC                 |  | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS      |  | 630    | IVE |
| 1   | EA | WALL STOP/HOLDER  | WS40                        |  | 626    | IVE |

REINFORCE DOOR FOR STOP/HOLDER.






**Hardware Group No. 36**

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER              |   | FINISH | MFR |
|-----|----|-------------------|-----------------------------|---|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP          |  | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050P6 06B 09-544 L283-711 |  | 626    | SCH |
| 1   | EA | WALL STOP         | WS406/407CCV                |  | 630    | IVE |




**Hardware Group No. 37**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER            |   | FINISH | MFR |
|-----|----|---------------------|---------------------------|---|--------|-----|
| 3   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP        |  | 652    | IVE |
| 1   | EA | PRIVACY W/COIN TURN | L9044 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | OH STOP             | 90S                       |  | 652    | GLY |
| 1   | EA | SURFACE CLOSER      | 4011 MC                   |  | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS    |  | 630    | IVE |

**Hardware Group No. 38**

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER            |   | FINISH | MFR |
|-----|----|---------------------|---------------------------|---|--------|-----|
| 3   | EA | HINGE               | 5BB1 4.5 X 4.5 NRP        |  | 652    | IVE |
| 1   | EA | PRIVACY W/COIN TURN | L9044 06B 09-544 L283-722 |  | 626    | SCH |
| 1   | EA | WALL STOP           | WS406/407CCV              |  | 630    | IVE |

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites and storefront framing.
2. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use the same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass 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 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Guardian Glass; SunGuard.
  2. Vitro.
  3. Substitutions: See Section 012500 - Product Requirements.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, registered in the State of Michigan to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
  1. Design Wind Pressures: per Michigan Building Code.
  2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is required by the building codes, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is required by the building codes, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.



## 2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seals.
  - 2. Perimeter Spacer: Manufacturer's standard warm-edge spacer material and construction.

## 2.7 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they 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. Sealant shall have a VOC content of 250 g/L or less.
  - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Available Products:
    - a. GE Silicones; Silglaze II SCS2800
    - b. Tremco; Tremsil 600
    - c. Dow Corning Corporation; 795
    - d. Substitutions: See Section 012500 - Product Requirements.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. 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.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch 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. Installation with Drive-in Wedge Gaskets: 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 weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 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.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type GL-B: Clear fully tempered float glass at all interior non-fire rated location except as noted.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.
  - 3. Substitutions: See Section 012500 - Product Requirements.

### 3.7 INSULATING GLASS SCHEDULE

- A. Glass Type GL-A: Low-E-coated, clear insulating glass at all exterior locations unless indicated otherwise. Provide laminated glass at hazardous locations requiring safety glazing as indicated on Drawings.
  - 1. Basis-of-Design Product, provide one of the following:
    - a. Guardian Glass; SunGuard SNX 62/27
    - b. Vitro (PPG); Solarban 70 XL

- c. Substitutions: See Section 012500 - Product Requirements.
- 2. Overall Unit Thickness: 1 inch (25 mm).
- 3. Minimum Thickness of Each Glass Lite: 6 mm.
- 4. Outdoor Lite: Heat-strengthened float glass.
  - a. Provide clear laminated glass with two plies of tempered float glass where indicated on Drawings.
    - 1) Minimum Thickness of Each Glass Ply: 3 mm.
- 5. Interspace Content: Argon.
- 6. Indoor Lite: Heat-strengthened float glass.
  - a. Provide fully tempered float glass where indicated on Drawings.
- 7. Low-E Coating: Sputtered on second surface.
- 8. Winter Nighttime U-Factor: .24 maximum.
- 9. Summer Daytime U-Factor: .21 maximum.
- 10. Visible Light Transmittance: 61 percent minimum.
- 11. Solar Heat Gain Coefficient: .27 maximum.
- 12. Safety glazing required.

END OF SECTION 088000

## SECTION 088300 - MIRRORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
  - 1. Annealed monolithic glass mirrors.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
  - 1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
  - 2. Mirror Clips: Full size.
  - 3. Mirror Trim: 12 inches (300 mm) long.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Preconstruction test report.
- B. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

#### 1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
  - 1. Warranty Period: 10 years from date of Substantial Completion, manufacture.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Avalon Glass and Mirror Company.
  - 2. Binswanger Mirror; a division of Vitro America, Inc.
  - 3. D & W Incorporated.

4. Donisi Mirror Company.
5. Gardner Glass, Inc.
6. Gilded Mirrors, Inc.
7. Glasswerks LA, Inc.
8. Guardian Glass; SunGuard.
9. Head West.
10. Independent Mirror Industries, Inc.
11. Lenoir Mirror Company.
12. National Glass Industries.
13. Stroupe Mirror Co., Inc.
14. Sunshine Mirror.
15. Trulite Glass & Aluminum Solutions, LLC.
16. Virginia Mirror Company, Inc.
17. Walker Glass Co., Ltd.
18. Substitutions: See Section 012500 - Product Requirements.

## 2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.
  1. Nominal Thickness: 6.0 mm.

## 2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating approved by mirror manufacturer.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
  1. Adhesives shall have a VOC content of 70 g/L or less.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

## 2.4 MIRROR HARDWARE

- A. Mirror Bottom Clips: Solid Brass mirror clip with anochrome finish.
- B. Mirror Top Clips: Manufacturer; C.R. Laurence, Inc. Solid Brass mirror clip with anochrome finish.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. Anchors and Inserts: Provide devices as required for mirror hardware installation.

## 2.5 FABRICATION

- A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- B. Mirror Edge Treatment: Flat polished. Seal edges of mirrors with edge sealer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

#### 3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

#### 3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Install mirrors with mastic and mirror hardware. 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 mirrors.
  - 1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
- C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

## SECTION 088723 - SAFETY AND SECURITY FILMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Safety and security films.

#### 1.2 RELATED SECTIONS

- A. Section 08 80 00 - Glazing: Substrate for application of safety and security film.

#### 1.3 SUBMITTALS

- A. Product Data: Submit for each product specified indicating:
  - 1. Performance properties.
  - 2. Preparation and installation instructions and recommendations.
  - 3. Storage and handling recommendations.
- B. Samples: For each type of safety and security film specified, two (2) samples, 12 inches square.
- C. Qualification Data: Submit documentation indicating qualifications of safety and security film manufacturer.
- D. Operation and Maintenance Data: Submit for safety and security film to include in maintenance manuals.
- E. Warranty: Submit sample special warranty specified in this section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is authorized by safety and security film manufacturer to install film in accordance with guidelines set forth by the manufacturer.
- B. Source Limitations: Obtain each type of safety and security film from same manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to evaluate surface preparation techniques and application workmanship.
  - 1. Construct mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at project site to discuss methods and procedures relating to installation of the safety and security films.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials in manufacturer's protective packaging.
- B. Store and protect materials according to manufacturer's written recommendations to prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

#### 1.6 SITE CONDITIONS

- A. Ambient Conditions: Maintain temperature, humidity, and ventilation within limits recommended by manufacturer.



## 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace films that fail within specified warranty period.
  - 1. Warranty Period: [10] [Insert number] years from date of original installation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Safety Glazing Impact resistance (performance to CPSC/ANSI Z97.1):
  - 1. Impact resistance for film applied on 1/8 inch (3 mm) thick glass: 400 foot-pounds (55 kilogram meters) minimum to comply with ANSI Z97.1 Class A and CPSC 16 CFR 1201 Category II as safety glass.
- B. Flammability (performance to ASTM E84):
  - 1. Flammability: Surface burning characteristics when tested in accordance ASTM E 84:
    - a. Flame Spread Index: 25, maximum.
    - b. Smoke Developed Index: 450, maximum.
- C. Abrasion resistance (performance to ASTM D1044):
  - 1. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
- D. Tear Resistance:
  - 1. Puncture propagation and tear resistance tested according to ASTM D2582: Greater than 33 Newton in both the machine direction (MD) and transverse direction (TD).

### 2.2 SAFETY AND SECURITY WINDOW FILM

- A. Safety and security window film:
  - 1. Type: Transparent, polyester, micro-thin film bonded to glass to resist impact, help contain glass shards, remain intact, and resist impact and explosive pressure and lessen blast damage;
  - 2. Basis-of-Design: Subject to compliance with requirements, provide the following:
    - a. 3M Commercial Solutions Division; Ultra 800 Safety & Security Film.
    - b. Architect approved equal. Substitutions: See Section 012500 - Product Requirements.
  - 3. Physical Properties.
    - a. Thickness: 8 mil (0.20 mm).
    - b. Construction: Multi-ply laminate.
    - c. Adhesive type: Pressure sensitive acrylic.
    - d. Tensile strength: (32,000 PSI) (2,250 kg per sq. cm) tested in accordance with ASTM D882.
    - e. Breaking strength: (240 pounds per inch) (4,286 grams per mm) minimum tested in accordance with ASTM D882.
    - f. Puncture and tear strength: 33.4 Newton average tested in accordance with ASTM D2582.
    - g. Peel strength: (5 pounds per inch) (89 grams per mm) minimum tested in accordance with ASTM D3330.

## 2.3 MISCELLANEOUS MATERIALS:

- A. Provide anchoring accessories as recommended by glazing film manufacturer and as required for complete installation meeting specified performance requirements.
- B. Structural Silicone Sealant: One-component, self-priming, elastomeric adhesive formulated for impact-resistant protective glazing in high performance window film application complying with ASTM C1184: DowSil 995 Silicone Structural Sealant or other equivalent product approved by glazing manufacturer.

## PART 3 - EXECUTION

### 3.1 GLAZING FILM APPLICATION

- A. Field apply glazing film in accordance with manufacturer's instructions at areas indicated on Drawings.
- B. Do not apply glazing film when surface temperature is less than 40 degrees F (4 degrees C).
- C. Inspection:
  - 1. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
  - 2. Verify glass is not cracked, chipped, broken, or damaged.
  - 3. Verify that frames are securely anchored and free of defects.
  - 4. Do not proceed until unsatisfactory conditions have been addressed.

### 3.2 PREPARATION

- A. Comply with manufacturers recommendations for surface preparation.
- B. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- C. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- D. Protect adjacent surfaces.

### 3.3 INSTALATION

- A. General Film Installation:
  - 1. Install in accordance with manufacturers written instructions and approved shop drawings.
  - 2. Accurately cut film with straight edges to required sizes allowing 1/16 to 1/8 inch (2 to 3 mm) gap at perimeter of glazed panel.
  - 3. Remove release liner immediately prior to adhering film to glass.
  - 4. Apply mounting solution to film and glass.
  - 5. Apply film to glass and removed air bubbles, wrinkles, and other defects using a squeegee. Three to five complete passes are required to completely remove mounting solution from between film and glass.
- B. DowSil 995 Silicone Structural Sealant Installation:
  - 1. Install in accordance with manufacturers written instructions and approved shop drawings for achieving blast resistance GSA Level 3A.
  - 2. Apply sealant without voids, install such that the sealant bridges glazing film and frame.
  - 3. A minimum of 1/2 inch triangular bead overlap on both the frame and film is required.
  - 4. Ensure a straight and consistent bead width by applying masking tape prior to sealant application.

5. Sealant shall be dispensed with a caulk gun with nozzle opening diameter matched to the size of bead width desired.
6. Tool exposed sealant surfaces to provide a clean smooth triangular shape.
7. Carefully remove any masking tape.

#### 3.4 FIELD QUALITY CONTROL

- A. After installation, view film from a distance of 10 feet (3 meters) against a light colored background. Ensure appearance is uniform without streaks, bands, thin spots, and pinholes in accordance with the IWFA Architectural Visual Inspection Standard for Applied Window Film.
- B. If installed film does not meet these requirements remove and replace with new film.

#### 3.5 CLEANING AND PROTECTION

- A. Inspect installation. Verify that it is complete and complies with requirements and manufacturer's instructions to provide specified anti-intrusion requirements. Correct deficiencies.
- B. Clean glass following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- C. Remove labels and protective covers.

END OF SECTION

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  - 2. Suspension systems for interior gypsum ceilings and soffits.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

#### 2.2 FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. Use steel studs and runners of actual thickness indicated.
  - 1. Minimum Base-Metal Thickness: 20 gauge (0.033 inch (0.84 mm)).
  - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
  - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
    - a. Products: Subject to compliance with requirements, provide one of the following. Substitutions: See Section 012500 - Product Requirements:
      - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
      - 2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
      - 3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
      - 4) Superior Metal Trim; Superior Flex Track System (SFT).
      - 5) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: 1-1/2 inches (38 mm).
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
  - 2. Depth: 7/8 inch (22.2 mm) and 1-1/2 inches (38.1 mm).

- F. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm) wide flanges.
  - 1. Depth: 3/4 inch (19 mm).
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- G. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required for thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
    - a. Type: Post-installed, chemical anchor or post-installed, expansion anchor.
  - 2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: 2 inches (51 mm).
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch (13 mm) wide flanges, 3/4 inch (19 mm) deep.
  - 2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
    - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
    - b. Depth: 2-1/2 inches (64 mm).
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
    - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
  - 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical.

## 2.4 AUXILIARY MATERIALS

- A. 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 asphalt saturated organic felt.

## PART 3 - EXECUTION

### 3.1 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. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-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.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- E. 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.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- 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, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
- 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. Do not attach hangers to steel roof deck.
- 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. 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.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Acoustical sound attenuation insulation.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. 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. American Gypsum.
  - 2. CertainTeed Corp.
  - 3. Georgia-Pacific Gypsum LLC.
  - 4. Lafarge North America Inc.
  - 5. National Gypsum Company.
  - 6. USG Corporation.
  - 7. Substitutions: See Section 012500 - Product Requirements.

#### 2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Thickness: 5/8 inch (15.9 mm).
  - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
  - 1. Thickness: 5/8 inch (15.9 mm).
  - 2. Long Edges: Tapered.
- C. Abuse Resistant Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Thickness: 5/8 inch (15.9 mm).
  - 2. Long Edges: Tapered.
  - 3. Indentation: ASTM C1629/C1629M. Level 2.
  - 4. Soft-Body Impact: ASTM C1629/C1629M, Level 2.

#### 2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.



## 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
  - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
  - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

## 2.5 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: Mineral-fiber blanket insulation consisting of fibers manufactured from rock or slag.
  - 1. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I (blankets, without membrane facing) with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Complying with ASTM E 413 - Rating for Sound Insulation.
    - a. Thickness and Density per ASTM C 167 for a minimum thickness of 2-inches with the density to be 2.5 lbs/cubic foot.
    - b. Acoustical Performance rating per ASTM C 423 with an Absorption Co-efficient at frequencies (NRC). For 2-inches thick the NRC shall be a minimum of 0.95.
  - 2. To be utilized at all interior partitions and columns where sound attenuation (acoustical) insulation is indicated on the Drawings.
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
    - b. Grabber Construction Products; Acoustical Sealant GSC.
    - c. Pecora Corporation; AC-20 FTR.
    - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    - e. USG Corporation; SHEETROCK Acoustical Sealant.
    - f. Substitutions: See Section 012500 - Product Requirements.
  - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. To be utilized at all interior partitions and columns indicated to have sound attenuation blankets on the Drawings.
- E. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch (3.2-mm) thick, in width to suite steel stud size.

### PART 3 - EXECUTION

#### 3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Gypsum board at wall bases must be separated from carpet by 1-inch minimum or use of waterproof film to prevent water transfer from floor.
- D. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- E. 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.
- F. 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.
- 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. Install 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.
  1. Aluminum Trim: Install in locations indicated on Drawings.
  2. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- J. Remove and replace panels that are wet, moisture damaged, and mold damaged.

#### 3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  1. Type X: Where required for fire-resistance-rated assembly and at all gypsum board locations, unless noted otherwise on Drawings.
  2. Ceiling Type: Provide sag-resistant gypsum board for ceiling application.
- 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.
  3. 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 one 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 and face layers separately to supports with screws.
- 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.

### 3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: L-shaped; exposed long flange receives joint compound.
  4. U-Bead: J-shaped; exposed short flange does not receive joint compound, use at exposed panel edges.

### 3.4 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: Ceiling plenum areas and concealed areas.
  2. Level 2: Where panels form substrates for ceramic and acoustical tile.
  3. Level 4: At panel surfaces that will be exposed to view.
    - a. Primer and its application to surfaces are specified in other Division 9 Sections.
- E. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second) and finish (third) coat of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
- F. For Level 2 gypsum board finish, embed tape in joint compound and apply first coat of joint compound.
- G. For Level 1 gypsum board finish, embed tape in joint compound.
- H. Tile Backing Panels: Finish according to manufacturer's written instructions.

### 3.5 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove them from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Ceramic wall tile.
  - 2. Tile backing panels.
  - 3. Grout materials.
  - 4. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
  - 1. Each type and composition of tile and for each color and finish required.
  - 2. Metal edge strips in 6" length

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.
  - 2. Locate extra materials where indicated by the Owner.
  - 3. Grout: Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. An experienced installer with a minimum of ten (10) years of experience installing similar types of ceramic tile.
  - 2. Installer uses best practices as outlined in the TCNA (Tile Council of North America) handbook.
- B. Pre-installation Meeting: Contractor to schedule a pre-installation meeting with the Architect and Construction Manager to verify selections made under sample submittals and to set quality standards for materials and execution.
  - 1. Contractor to provide a mockup as part of the Pre-installation meeting. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

### 2.2 TILE PRODUCTS

- A. Ceramic Tile Types: Ceramic tile for walls. Refer to "Finish Material Schedule" on drawing A3.00 for product information.
  - 1. Grout Color: As selected by Architect from manufacturer's full range.

### 2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Gypsum LLC.
    - b. USG Corporation.
    - c. Substitutions: See Section 012500 - Product Requirements.
  - 2. Thickness: 1/2 inch (12.7 mm).
  - 3. Application areas: Backing panels shall be installed in the locations specified and as indicated in the drawings.
    - a. Walls with the following conditions:
      - 1) 2 or more dissimilar surface materials
      - 2) New construction abutting existing in the same plane.
      - 3) Existing construction with uneven surfaces that prevent tile installation to be level and plumb. Refer to TCNA guidelines "Subsurface Tolerances for Thin-Bed Method".

### 2.4 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LATICRETE International, Inc; Laticrete 254 Platinum; or a comparable product by one of the following:
    - a. ARDEX Americas.
    - b. Bonsal American, an Oldcastle company.
    - c. Bostik, Inc.
    - d. H.B. Fuller Construction Products Inc. / TEC.
    - e. MAPEI Corporation.
    - f. Substitutions: See Section 012500 - Product Requirements.
  - 2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
  - 3. For wall applications, provide non-sagging mortar.

## 2.5 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. High-Performance Tile Grout: ANSI A118.7.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LATICRETE International, Inc.; PermaColor Grout or a comparable product by one of the following:
    - a. ARDEX Americas.
    - b. Bonsal American, an Oldcastle company.
    - c. Bostik, Inc.
    - d. H.B. Fuller Construction Products Inc. / TEC.
    - e. MAPEI Corporation.
    - f. Substitutions: See Section 012500 - Product Requirements.
  - 2. Polymer Type: Dry, re-dispersible form, prepackaged with other dry ingredients.
  - 3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LATICRETE International, Inc.; SpectraLOCK or a comparable product by one of the following:
    - a. ARDEX Americas.
    - b. Bonsal American, an Oldcastle company.
    - c. Bostik, Inc.
    - d. H.B. Fuller Construction Products Inc. / TEC.
    - e. MAPEI Corporation.
    - f. Substitutions: See Section 012500 - Product Requirements.

## 2.6 ELASTOMERIC SEALANTS

- A. Refer to Section 079200 "Joint Sealants" for sealant requirements.

## 2.7 MISCELLANEOUS MATERIALS

- A. Trowel-able 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: Angle or L-shape, height to match tile and setting-bed thickness, stainless steel, ASTM A 666, 300 Series.
  - 1. Manufacturer: Provide Schluter Systems or Architect-approved equal. Substitutions: See Section 012500 - Product Requirements.
  - 2. Schedule of Profiles:
    - a. Metal Edge Strips: Height to match tile and setting-bed thickness, anodized aluminum.
    - b. Provide outside corner metal trims at tile locations unless otherwise indicated on drawings. RONDEC. Satin Anodized Aluminum.
    - c. Provide metal edge trim where wall tile meets dissimilar material. JOLLY. Satin Anodized Aluminum.

## 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 the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile walls installed with thinset mortar with trowel-able leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Ceramic tile walls
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. 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.
- D. Jointing Pattern: Lay tile in patterns indicated on drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  1. Ceramic Wall Tile: 3/16 inch.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, as recommended by TCNA. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
  2. Review locations of expansion joints with Architect prior to installation.
  3. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants".



- G. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Masonry or Concrete:
  - 1. Ceramic Tile Installation: TCNA W202; thinset mortar.
    - a. Ceramic Tile
    - b. Thinset Mortar: Modified dry-set mortar.
    - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Backer Board over Metal Studs:
  - 1. Ceramic Tile Installation: TCNA W244C; thinset mortar.
    - a. Ceramic Tile
    - b. Thinset Mortar: Modified dry-set mortar.
    - c. Grout: High-performance sanded grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics:
  - 1. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
    - a. Smoke-Developed Index: 450 or less.
- C. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

- A. Manufacturer's standard form where manufacturer agrees to replace defective products within the specified period:
  - 1. Warranty Period: 30 years against visible sag, mold, mildew, and bacteria.

1.5 PROJECT CONDITIONS

- A. Environmental Limitation: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

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 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 panels equal to 5.0 percent of quantity installed.
  - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

## 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. Basis-of-Design products: Armstrong World Industries, Inc.,  
Subject to compliance with requirements, provide products specified.
    - a. Celotex Corporation
    - b. CertainTeed Corp.
    - c. Substitutions: See Section 012500 - Product Requirements.

### 2.2 GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M Class 1 zinc coating, soft temper.
  - 1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. 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, finish, and color as that used for exposed flanges of suspension system runners. Where bullnose corners occur, provide preformed corners to match edge moldings.
- F. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

### 2.3 ACOUSTICAL PANELS,

- A. Products: **ACT-1:**
  - 1. Basis-of-Design: USG Interiors, Inc.; Product: Radar Clima-Plus High-NRC.
  - 2. Color: White.
  - 3. LR: Not less than 0.84.
  - 4. NRC: Not less than 0.70.
  - 5. CAC: Not less than 35.
  - 6. Edge Detail: Square.
  - 7. Thickness: 3/4 inch.
  - 8. Size: 24 by 24.
- B. Products: **ACT-2:**
  - 1. Basis-of-Design: Armstrong, Inc.; Product: Metalworks Securelock.
  - 2. Color: White
  - 3. LR: Not less than 0.75.
  - 4. Accessories: Security Screws
  - 5. Edge Detail: Square.
  - 6. Thickness: 1 inch.

7. Size: 24 by 24.

## 2.4 METAL SUSPENSION SYSTEM

- A. Wide-Face Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, and hot-dip galvanized according to ASTM A 653/A 653M, with prefinished 15/16-inch-wide metal caps on flanges.
  1. Structural Classification: Intermediate-duty system.
  2. End Condition of Cross Runners: Butt-edge type.
  3. Cap Material: Steel cold-rolled sheet.
  4. Cap Finish: Painted white.
- B. Basis-of-Design Manufacturer: USG Interiors, Inc.
  1. Equal products as manufactured by Armstrong World Industries, Inc., CertainTeed Corporation, or Celotex Corporation are also acceptable.
  2. Substitutions: See Section 012500 - Product Requirements.
- C. Schedule of Suspension System Types:
  1. Donn DX/DXL.
  2. Prelude DX/DXL.
  3. Substitutions: See Section 012500 - Product Requirements.
- D. Provide manufacturer's standard wall molding for all ceiling types.
- E. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  1. Do not attach hangers to steel deck tabs or to steel roof deck. Attach hangers to structural members.
  2. Space hangers not more than 48-inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8-inches (200 mm) from ends of each member.
  3. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- D. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate

at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

### 3.2 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings and suspension system members. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Resilient base.
  - 2. Resilient Stair accessories.
  - 3. Resilient molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE: **RWB-1**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Roppe Corporation
  - 2. Substitutions: See Section 012500 - Product Requirements.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
  - 1. Group: I Solid
  - 2. Profile: Standard Cove with Toe
- C. Height: 4 inches.
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: refer to "Finish Material Schedule" on drawing A3.00.

2.2 RESILIENT WALL BASE: **RWB-2**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Roppe Corporation
  - 2. Substitutions: See Section 012500 - Product Requirements.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
  - 1. Group: I Solid
  - 2. Profile: Standard Cove with Toe
- C. Height: 6 inches.
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: refer to "Finish Material Schedule" on drawing A3.00.

2.3 RESILIENT WALL BASE: **RWB-3**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Tarkett Vent Cove Wall Base

- 2. Substitutions: See Section 012500 - Product Requirements.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
  - 1. Group: I Solid
  - 2. Profile: Standard Cove with Toe
- C. Height: 4 inches.
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: refer to "Finish Material Schedule" on drawing A3.00.

## 2.4 RESILIENT MOLDING ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Roppe Corporation
  - 2. VPI, LLC: Floor Products Division
  - 3. Armstrong World Industries, Inc.
  - 4. Johnsonite, Inc.
  - 5. Burke Industries, Inc.
  - 6. Flexco, Inc.
  - 7. Mondo Rubber International, Inc.
  - 8. Nora Rubber Flooring
  - 9. Mannington Commercial
  - 10. Tarkett USA, Inc.
  - 11. Substitutions: See Section 012500 - Product Requirements.
- B. Description: Rubber carpet edge for glue-down applications, reducer strip for resilient flooring and transition strips.
- C. Profile and Dimensions: As required per condition. Profile must comply with ADA requirements.
- D. Locations: Provide rubber moldings at all areas where dissimilar flooring materials meet.

## 2.5 STAIR TREADS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Roppe Corporation
  - 2. Substitutions: See Section 012500 - Product Requirements.
- B. Product Standard: ASTM F 2169
  - 1. Type: TP (rubber, thermoplastic).
  - 2. Class: 2 (pattern; embossed, grooved, or ribbed).
  - 3. Group: 2 (with contrasting color for the visually impaired).
  - 4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
  - 5. Nosing Height: 1-1/2 inches (38 mm).
  - 6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
  - 7. Size: Lengths and depths to fit each stair tread in one piece.
  - 8. Integral Risers: Smooth, flat; in height that fully covers substrate.
- C. Colors and Patterns: As indicated in "Finish Material Legend".

## 2.6 INSTALLATION MATERIALS

- A. Trowel-able 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 resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. 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. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowel-able leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, and areas where base is required as shown on the drawings.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.



- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter corners to minimize open joints.

### 3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply two coats.
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Luxury Vinyl Tile Flooring

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

1.5 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 that 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.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 LUXURY VINYL TILE FLOORING

- A. Refer to Drawings "Finish Material Schedule" for product selections and "Finish Floor Plan" for room finishes and layout patterns.

### 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to 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.
- I. Floor Polish at Homogenous Vinyl Tile: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply floor finish in accordance with manufacturer's recommendations.

END OF SECTION 096519

## SECTION 096723 - RESINOUS FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes resinous flooring systems.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of exposed finish required.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D 635.

## 2.2 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. System Characteristics:
  - 1. Basis of design: As indicated in "Finish Material Legend".
  - 2. Color and Pattern: As selected by Architect from manufacturer's full range.
  - 3. Wearing Surface: Textured for slip resistance.
  - 4. Overall System Thickness: 1/8 inch (3.2 mm).
  - 5. Federal Agency Approvals: Approved for food-processing environments.
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- E. Body Coats:
  - 1. Resin: Epoxy.
  - 2. Formulation Description: 100 percent solids.
  - 3. Type: Pigmented.
  - 4. Application Method: Self-leveling slurry with broadcast aggregates.
  - 5. Number of Coats: One.
  - 6. Thickness of Coats: 1/16 inch (1.6 mm).
  - 7. Aggregates: Manufacturer's standard.
- F. Topcoats: Sealing or finish coats.
  - 1. Resin: Epoxy.
  - 2. Formulation Description: 100 percent solids.
  - 3. Type: Clear.
  - 4. Number of Coats: One.
  - 5. Thickness of Coats: 1/16 inch (1.6 mm).
  - 6. Finish: Matte.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

- a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring 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) of slab area in 24 hours.
  - b. Plastic Sheet Test: ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
  - c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

### 3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions. Round internal and external corners.
  - 1. Integral Cove Base: 4 inches (100 mm) high.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
  - 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- G. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- H. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
- I. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile.

1.2 REFERENCES

- A. Safety Data Sheets (MSDS or SDS)
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM D 1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
  - 2. ASTM D 2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Coverings (Pill Test)
  - 3. ASTM D 3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Coverings
  - 4. ASTM D 5252 - Standard Practice for the Operation of the Hexapod Tumble Drum Tester
  - 5. ASTM E 492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine
  - 6. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
  - 7. ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
  - 8. ASTM E 989 - Standard Classification for Determination of Impact Insulation Class (IIC)
  - 9. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
  - 10. ASTM F 141 - Standard Terminology Relating to Resilient Floor Coverings
  - 11. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
  - 12. ASTM F 1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
  - 13. ASTM F 1861 - Standard Specification for Resilient Wall Base
  - 14. ASTM F 1869 - Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  - 15. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
  - 16. ASTM F 2419 - Standard Practice for Installation of Thick Poured Gypsum Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
  - 17. ASTM F 2471 - Standard Practice for Installation of Thick Poured Lightweight Cellular Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
  - 18. ASTM F 2659 - Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter
  - 19. ASTM F 2678 - Standard Practice for Preparing Panel Underlayments, Thick Poured Gypsum Concrete Underlayments, Thick Poured Lightweight Cellular Concrete



- Underlayments, and Concrete Subfloors with Underlayment Patching Compounds to Receive Resilient Flooring
20. ASTM F 3191 - Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring

C. National Fire Protection Association (NFPA):

1. NFPA 253 - Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
2. NFPA 258 - Test Method for Specific Optical Density of Smoke Generated by Solid Materials

D. American Association of Textile Chemists and Colorists (AATCC):

1. AATCC 16E - Colorfastness to Light
2. AATCC 107 - Colorfastness to Water
3. AATCC 134 - Electrostatic Propensity of Carpets
4. AATCC 165 - Colorfastness to Crocking: Textile Floor Coverings Crockmeter Method

### 1.3 PREINSTALLATION MEETINGS

- A. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation and floor care recommendations and manufacturer's warranty requirements.
- B. Pre-Installation Testing: Conduct and document pre-installation testing as specified by manufacturer in accordance with the latest version of the specified test methods.
1. Substrate Porosity Testing: ASTM F 3131 - Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring.
  2. pH testing: ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  3. In-situ Relative Humidity Testing: ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
  4. Calcium Chloride Testing: ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  5. Surface Moisture Testing: ASTM F 2659 - Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and other Floor Slabs and Screeds Using a Non- Destructive Electronic Moisture Meter.
  6. Bond Testing: Conduct testing and document results in accordance with the manufacturer's recommendations.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  2. Carpet tile type, color, and dye lot.
  3. Type of subfloor.
  4. Type of installation.

5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

- C. Samples: Submit three (3) sets of samples of each type, color and finish of flooring and accessory products specified, with an indication of full range of color, pattern and texture variation. Provide samples with a minimum size of 6" x 9" for flooring products and 6" in length for accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Submit three (3) copies of the maintenance and operations data. This should include methods for maintaining the installed products and any precautions against cleaning materials or methods that are detrimental to the product and their performance.
- B. Submit three (3) copies of the warranty as specified herein.
- C. Installer Certification: Submit proof of certification from the manufacturer certifying that the installers comply with the specified requirements.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Manufacturer: Whenever possible, provide each type of flooring as provided by a single manufacturer, including recommended primers, adhesives, sealants, patching and leveling compounds.
- C. Flooring Contractor Qualifications:
  1. The awarded flooring contractor shall be an established firm, experienced in the installation of the specified product and shall have access to all manufacturer's required specifications, technical, installation and maintenance related documents.
- D. Pre-Installation Meeting: Conduct pre-installation meeting to discuss layout prior to installation.
- E. Post-Installation Meetings: Conduct post-installation meetings to review methods and procedures related to floor care and warranty requirements.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
- B. Manufacturer's Warranty: Submit the manufacturer's standard warranty document executed by authorized company official for Owner's acceptance. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
  - 1. Warranty Period: Twenty (20) year limited warranty commencing on Date of Original Purchase from manufacturer.
- C. Installation Warranty: Submit the flooring contractor's installation warranty signed by the General Contractor and Installer for Owner's Acceptance, agreeing to repair or replace work which has failed as a result of defects in workmanship. Failure shall include, but not limited to, tearing, cracking, separation, deterioration or loosening from substrate, seam failure, ripples, bubbling or puckering. Upon notification of such installation deficiencies, within the warranty period, make necessary repairs or replacement at the convenience of the Owner. Other guaranties or warranties may not be substituted by the Contractor for the terms of this warranty. Installation warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
  - 1. Warranty Period: Two (2) year limited warranty commencing on Date of Substantial Completion from flooring contractor.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with the manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  - 1. All materials (flooring, adhesives and accessories) should be stored in areas that are fully enclosed and weathertight. The permanent HVAC should be fully operational and controlled and set at a minimum temperature 65° F (18.3° C). If this is not possible, the areas should be acclimated and controlled by means of temporary HVAC to the service level conditions expected during occupancy. The temperature and humidity should range from 75° F ± 10°F (23.9° C ± 5.5° C) with a 50% ± 10% ambient relative humidity.
  - 2. Store modular cartons stacked per the manufacturer's recommendations.
  - 3. Comply with the manufacturer's recommendation for the acclimation of all materials in the space where they will be installed for at least 48 hours prior to the installation unless longer conditioning periods are required by the manufacturer.

1.10 ATTIC STOCK

- A. Provide the Owner with 5% attic stock.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE

- A. Refer to Drawings "Finish Material Schedule" for product selections and "Finish Floor Plan" for room finishes and layout patterns.

### 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 comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Resilient Edge Strips: Strips shall be homogeneous vinyl or rubber composition with a tapered or bull nose edge no less than 1" wide, colored to match flooring or as selected by Architect from standard colors available.
  - 1. Specify colors and patterns as selected by Architect.
- D. Metal Edge Strips: Strips shall be of width shown and of required thickness to protect the exposed edge of the flooring with units in maximum length available to minimize the number of joints.
  - 1. Specify colors and patterns as selected by Architect.
- E. Wall Base: Provide rubber wall base complying with FS SS-W-40, Type I.
  - 1. Specify colors and patterns as selected by Architect.
- F. Floor Care Products: Provide products as required in Section 3.7 Cleaning.
  - 1. Specify cleaning chemicals and equipment as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. 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. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

### 3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- 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. Concrete Substrates: 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 adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.
- E. Bond Testing
  - 1. Conduct testing in accordance with the manufacturer's recommendations in various locations throughout the area where flooring is to be installed. Although the number of tests required may vary, enough tests should be performed to allow an evaluation of the entire area where material will be installed.

### 3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," 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. Maintain pile-direction patterns as indicated.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. 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.
- J. Finish Flooring Patterns: As indicated in Drawings and Specifications.

### 3.4 PROTECTION

- A. Protection: Do not allow heavy traffic or rolling loads for at least 72 hours following the installation. Additional time may be necessary if the installation is over a non-porous substrate. Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

### 3.5 CLEANING

- A. Initial Maintenance: In order to allow the adhesive to dry and cure properly, wait a minimum of five days following the installation before conducting wet cleaning procedures or initial maintenance. Additional time may be necessary if the installation is over a non-porous substrate.
- B. Procedure: Refer to Operations and Maintenance data from the manufacturer.

END OF SECTION 096813

## SECTION 098436 - SOUND-ABSORBING CEILING UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes shop-fabricated, sound-absorbing acoustical cloud units tested for acoustical performance.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Product certificates.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 ACOUSTIC PANELS

- A. Refer to Drawings "Finish Material Schedule" for product selections and "Reflected Ceiling Plans" for layout patterns.

#### 2.2 METAL SUSPENSION SYSTEM

- A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A653. Main beams and cross tees are double-web steel construction with 15/16" type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
  - 1. Structural Classification: ASTM C 635 Intermediate duty.
  - 2. Color: Standard White unless noted otherwise.
  - 3. Acceptable Product: Prelude XL 15/16" as manufactured by Armstrong World Industries.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

- C. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge

## 2.3 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.
- C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

### 3.2 PAINTING

- A. Reference Specification Section 099123 Interior Painting and manufacturer's recommendations.

END OF SECTION 098436



## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes all labor, materials, tools and other equipment, services and supervision required to complete all interior and exterior painting work, including:
  - 1. Moisture testing of substrates.
  - 2. Surface preparation of all new and existing substrates as required for acceptance of paint, including cleaning, small crack repair, patching, caulking, and making good surfaces and areas to the limits defined under the MPI Preparation requirements.
  - 3. Sealing or priming of all new and existing surfaces for repainting per MPI requirements.
  - 4. Provision of safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile/flammable materials are being used.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

#### 1.4 QUALITY ASSURANCE

- A. All materials, preparation and workmanship shall conform to requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute (MPI).
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
- C. All surfaces requiring repainting shall be inspected by the Painting Contractor who shall notify the Architect and General Contractor in writing of any defects or problems, prior to commencing repainting or after preparation work.

## 1.5 PROJECT CONDITIONS

- A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
- B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- D. Do not apply paint when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in finish systems schedules or comparable products by one of the following:
  - 1. Basis-of-Design: Sherwin Williams.
  - 2. Benjamin Moore.
  - 3. PPG Industries.
  - 4. Pratt & Lambert.
  - 5. Substitutions: See Section 012500 - Product Requirements.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- D. Colors: Provide colors in accordance with University Master Interior Paint Color Palette, based on Sherwin-Williams colors. Refer to Drawings for color selections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Prior to commencement of Work, thoroughly examine (and test as required) all interior conditions and surfaces scheduled to be painted / repainted and report in writing to the Owner and General Contractor any conditions or surfaces that will adversely affect work of this section.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (CMUs): 12 percent.
  - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" and "MPI Repainting Manual" applicable to substrates and paint systems indicated.
- B. Prepare all surfaces in accordance with MPI requirements.
- C. Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.
- D. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- E. Protect all adjacent interior surfaces and areas, including door hardware and rating and instruction labels on doors, frames, equipment, piping, etc., from painting and repainting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Sand and dust between each coat to provide an anchor for next coat and to remove defects in previous coat (runs, sags, etc.) visible from a distance up to 1000 mm (39 inches).
- C. Do not apply finishes on interior surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates: All exposed CMU construction.
  - 1. Latex System MPI INT 4.2A: All spaces unless noted otherwise.
    - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
      - 1) Benjamin Moore: Ultra Spec Int/Ext High-Build Block Filler 571/K571.
      - 2) PPG: Glidden Concrete Coatings Block Filler Int/Ext Primer 3010-1200.
      - 3) S-W: Loxon Block Surfacer A24W200.
      - 4) Substitutions: See Section 012500 - Product Requirements.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
      - 1) Benjamin Moore: Super Hide Zero VOC Interior Eggshell.
      - 2) PPG: Speedhide Zero Interior Zero VOC Latex Satin.
      - 3) S-W: ProMar 200 Zero VOC Interior Latex Eggshell.
      - 4) Substitutions: See Section 012500 - Product Requirements.
- B. Steel Substrates: Metal doors and frames and other steel surfaces.
  - 1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:
    - a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
      - 1) Benjamin Moore: Super Spec HP D.T.M. Acrylic Low Lustre P25.
      - 2) PPG: Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-909.
      - 3) S-W: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
      - 4) Substitutions: See Section 012500 - Product Requirements.

- b. Topcoats: Latex, interior, institutional low odor/VOC (MPI Gloss Level 5), MPI #147.
  - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Gloss Finish N540.
  - 2) PPG: Glidden Diamond 450 No VOC Interior Semi-Gloss 7400N.
  - 3) S-W: Pro Industrial Acrylic Gloss Coating, B66-660 Series.
  - 4) Substitutions: See Section 012500 - Product Requirements.
- 2. Water-Based Dry-Fall System MPI INT 5.1C:
  - a. Prime Coat: Shop primer specified in Section where substrate is specified.
  - b. Topcoat: Dry fall, latex, flat, MPI #118.
    - 1) Benjamin Moore: Super Kote 5000 Dry Fall Acrylic Latex N110.
    - 2) PPG: Glidden Professional Waterborne Flat Dryfall 1280.
    - 3) S-W: Pro Industrial Waterborne Acrylic Dry Fall B42W00181.
    - 4) Substitutions: See Section 012500 - Product Requirements.
- C. Gypsum Board Substrates:
  - 1. Latex over Latex Sealer System MPI INT 9.2A:
    - a. Prime Coat: Primer sealer, MPI #50.
      - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Latex Primer N534.
      - 2) PPG: Speedhide Zero Interior Zero VOC Latex Sealer 6-4900XI.
      - 3) S-W: ProMar 200 Zero VOC Latex Primer, B28W2600.
      - 4) Substitutions: See Section 012500 - Product Requirements.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
      - 1) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Eggshell Finish N538.
      - 2) PPG: Glidden Diamond 350 Interior Eggshell 1403.
      - 3) S-W: ProMar 200 Zero VOC Latex Egg-Shell, B20-2600 Series.
      - 4) Substitutions: See Section 012500 - Product Requirements.

END OF SECTION 099123

## SECTION 099300 - STAINING AND TRANSPARENT FINISHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes on interior wood substrates.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of finish system and in each color and gloss of finish required.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of stain color selections will be based on mockups.
    - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in wood finish systems schedules.

## 2.2 MATERIALS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
  - 1. Clear Wood Finishes, Varnishes: 350 g/L.
  - 2. Clear Wood Finishes, Lacquers: 550 g/L.
  - 3. Shellacs, Clear: 730 g/L.
  - 4. Stains: 250 g/L.
- D. Stain Colors: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

- A. Wood Substrates:
  - 1. Polyurethane Varnish over Stain System:
    - a. Stain Coat: Stain, semitransparent, for interior wood.
      - 1) Benjamin Moore - Lenmar - Wiping Wood Stain, 1WB.1300
      - 2) S-W Wood Classics Interior Oil Stain, A49-800 Series.
      - 3) Substitutions: See Section 012500 - Product Requirements.
    - b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    - c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4).
      - 1) Benjamin Moore - Lenmar - AquaPlastic Urethane Clear (Acrylic Polyurethane), 1WB.14XX.
      - 2) S-W Wood Classics Waterborne Polyurethane Varnish, A68 Series.
      - 3) Substitutions: See Section 012500 - Product Requirements.

END OF SECTION 099300

## SECTION 099600 - HIGH-PERFORMANCE COATINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
  - 1. Exterior Metal Substrates.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
    - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the High-Performance Coating Schedule for the coating category indicated.

#### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As selected by Architect.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

#### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

#### 3.4 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Metal Substrates: Exposed structural steel, decorative metal ornaments, doors and window frames.
  - 1. Polyurethane over Epoxy System:
    - a. Basecoat: Epoxy, High Build, Low Gloss.
      - 1) AzkoNobel: Devoe Bar Rust 235.
      - 2) PPG: Protective & Marine Aquapon High Build Epoxy.
      - 3) S-W: Protective & Marine Macropoxy 646 FC.
      - 4) Substitutions: See Section 012500 - Product Requirements.
    - b. Intermediate Coat: Polyurethane, matching topcoat.
    - c. Topcoat: Two-part Polyurethane, Semi-Gloss.
      - 1) AzkoNobel: Devoe Devthane 379.
      - 2) PPG: Protective & Marine Pitthane Ultra Gloss, 95-812 Series.
      - 3) S-W: Protective & Marine Hi-Solids Polyurethane, B65-350.
      - 4) Substitutions: See Section 012500 - Product Requirements.

END OF SECTION 099600

## SECTION 101100 - VISUAL DISPLAY UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Visual display board assemblies.
  - 2. Markerboards.
  - 3. Tackboards.
  - 4. Tackable Panels
  - 5. Display rails.
  - 6. Art Hanging System.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints.
- C. Samples: (1) physical sample for each type of visual display unit indicated.
- D. Product Schedule: For visual display units.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 50 years from date of Substantial Completion.
  - 2. Warranty Period: Life of the building.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 MANUFACTURER

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Claridge Products and Equipment, Inc; or a comparable product by one of the following:
1. AARCO Products, Inc.
  2. Egan Visual Inc.
  3. Marsh Industries, Inc.
  4. Peter Pepper Products, Inc.
  5. Architect approved equal.

## 2.3 MARKERBOARDS (WHITEBOARD SP-01, SP-01A, SP-01B)

Basis of Design product: Claridge 800 Series with LCS surface.

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
1. Face Sheet Thickness: 0.021 inch (0.53 mm) uncoated base metal thickness.
  2. Medium-Density Fiberboard Core: 7/16 inch (11 mm) thick; with manufacturer's standard moisture-barrier backing.
  3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
  4. Full length marker tray and map rail with 2 map hooks.
  5. 5/8" face frame, anodized aluminum, satin finish.
  6. LCS writing surface, color: 100 White.

## 2.4 TACKBOARDS (TACKBOARD SP-02, SP-02A, SP-02B)

Basis of Design Product: Claridge Tackboard 800 Series with Fabricork surface.

- A. Vinyl- faced tackboard units: factory-laminated tackboard assembly consisting of moisture-barrier backing, core material, and vinyl fabric face sheet.
1. 5/8" face frame, anodized aluminum, satin finish.
  2. Fabricork surface, color: To be selected by Architect from manufacturer's standard colors.

## 2.5 ART HANGING SYSTEM (ART TRACK SP-03)

Basis of Design Product: AS Hanging Display Systems, "Casso Display Rail".

- A. Commercial grade art display system consisting of materials and components required to provide a complete system for hanging artwork or signage of various sizes and types using a non-roller design.
1. Mounting: linear wall
  2. Configuration: As indicated on drawings.
  3. Rail: Extruded aluminum wall track in 6 foot sections.
  4. Finish: Satin Anodized Silver
  5. Include all accessories for a complete system such as rail end caps, tensioners, etc. as recommended by the manufacturer.
  6. Dimensions: Refer to Drawings for layout, sizes and quantities.

## 2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. High-Pressure Plastic Laminate: NEMA LD 3.
- C. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- D. Composite Wood Products: Products shall be made without urea formaldehyde.
- E. Hardboard: ANSI A135.4, tempered.
- F. Particleboard: ANSI A208.1, Grade M-1.
- G. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
- H. Fiberboard: ASTM C 208 cellulosic fiber insulating board.
- I. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- J. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.
- C. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

END OF SECTION 101100

## SECTION 10 1400 - SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Room and door signs.
- B. Dimensional characters.

#### 1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

#### 1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on each type of sign.
- C. Shop Drawings: For each sign type, provide dimensioned elevation including letter sizes and locations, graphics, colors and finishes, mounting methods, mounting heights, and material descriptions.
- D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- E. Samples:
  - 1. Room and Door Signs: Submit 3 samples of each type of sign construction, of size similar to that required for project, illustrating sign style, font, colors, and method of attachment.
  - 2. Dimensional Characters: Submit 3 samples, full size, of each dimensional character style, font, color, and method of attachment.
    - a. For specified sizes 12 inches and under, provide samples matching specified size.
    - b. For specified sizes over 12 inches, provide 12 inch high samples unless actual specified size requested by Architect.
  - 3. Plaques: Provide samples upon Architect's request.
- F. Verification Samples: Submit samples showing colors specified.
  - 1. Where colors are not specified, submit two sets of color selection charts or chips.
- G. Maintenance Data: Include data on regular cleaning.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Store tape adhesive at normal room temperature.

#### 1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Room and Door Signs:
  - 1. ASI Signage Innovation: [www.asisignage.com](http://www.asisignage.com).
  - 2. Inpro Corporation: [www.inprocorp.com](http://www.inprocorp.com).
  - 3. Foresight Supersign: [www.foresightsupersign.net](http://www.foresightsupersign.net).
  - 4. The Supersine Company: [www.supersine.com](http://www.supersine.com).
  - 5. Summit Advertising, Inc...
  - 6. Substitutions: See Section 01 2500 - Substitution Requirements.
- B. Dimensional characters:
  - 1. A.R.K. Ramos: [www.arkramos.com](http://www.arkramos.com).
  - 2. Gemini Inc.: [www.geminiisignproducts.com](http://www.geminiisignproducts.com).
  - 3. Substitutions: See Section 01 2500 - Substitution Requirements.

#### 2.2 ROOM AND DOOR SIGNS

- A. Sign Type: Flat signs with die-raised panel media as specified. Tactile characters and Braille shall be integral to sign face; separate adhesively-fixed characters are not permitted. Frameless.
  - 1. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
- B. Materials:
  - 1. Sign Material: Face material shall be 1/16" thickness transparent non-glare, optically corrected, acrylic sheet with reverse screen printed colored border and stripe, leaving center see-through areas for inserts..
  - 2. Backing Plate: None, unless otherwise indicated.
- C. Sign Properties:
  - 1. Sign Sizes and Shapes: As indicated.
  - 2. Character and Graphic Layouts: As indicated.
  - 3. Character Styles (Fonts): As indicated.
  - 4. Character Sizes: As indicated.
  - 5. Pictograms and Graphics: As indicated.
- D. Colors and Finish:
  - 1. First Background Colors: As indicated.

2. Character Colors: As indicated.
3. Pictograms and Graphics Colors: As indicated.
- E. drop down Miscellaneous:
  1. Changeable Message Inserts: Manufacturer's standard "window" section for replaceable text inserts; provide where indicated.
    - a. Window shall have a transparent cover to protect changeable messages.
    - b. Windows shall accommodate printed paper and engraved inserts.
    - c. Unless otherwise indicated, window opening shall have corner radiuses of 1/4 inch.
- F. Mounting:
  1. Walls Tape adhesive.
  2. Glass: Tape adhesive with matching plate of same material as sign, on opposite side of glass to conceal mounting materials.
  3. Bracket-Mounted 2-Sided Signs - Walls and Ceilings: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes.
- G. Locations - General:
  1. Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
- H. Sign Layouts - General: Unless otherwise indicated provide the following:
  1. Classrooms and Offices: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide changeable message inserts. Include braille.
  2. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings. Include braille.
  3. Storage and Janitor's Closet Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings. Include braille.
  4. Mechanical, Electrical, and Other Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings. Include braille.
  5. Rest Rooms: Identify with pictograms, the names "MEN" or "BOYS" and "WOMEN" or "GIRLS", and braille.
  6. Stairways: Identify with pictograms and the name "STAIR", and braille.
  7. Elevators: Identify with pictograms and the name "ELEVATOR", and braille.
    - a. Emergency Text and Pictograms: Comply with requirements of authorities having jurisdiction indicating that in case of fire, elevators are out of service and stairway exits should be used instead.

## 2.3 DIMENSIONAL CHARACTERS

- A. Metal Characters:
  1. Cast Characters: Form individual characters by casting.
    - a. Fabricate characters with smooth surfaces and precisely formed profiles, lines, and edges; without pits and other imperfections. Cast lugs into back of characters and tap for threaded mounting studs.
    - b. Material:
      - 1) Aluminum: In alloy and temper as recommended by dimensional character manufacturer.
    - c. Character Styles (Fonts): As indicated.
    - d. Character Sizes: As indicated.
    - e. Finish: Clear anodized.
    - f. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide fasteners as applicable for substrates indicated.
      - 1) Projected Mounting: Mount dimensional characters 1 inch off

- substrate; from face of substrate to back of dimensional character.
- 2) At exterior locations, provide stainless steel fasteners and hardware.
- 2. Cut Characters: Cut characters from solid plate of thickness and metal indicated.
  - a. Precisely cut characters with smooth square edges.
  - b. Characters shall be flat and free of warps, distortions, or other surface imperfections.
  - c. Material:
    - 1) Aluminum Plate: ASTM B209 in alloy and temper as recommended by dimensional character manufacturer.
      - (a) Thickness: 3/8 inch.
  - d. Character Styles (Fonts): As indicated.
  - e. Character Sizes: As indicated.
  - f. Finish: Clear anodized.
  - g. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide fasteners as applicable for substrates indicated.
    - 1) Projected Mounting: Mount dimensional characters 1 inch off the substrate; from face of substrate to back of dimensional character.
    - 2) At exterior locations, provide stainless steel fasteners and hardware.
- 3. Fabricated Characters: Cut characters from metal sheet and thickness indicated.
  - a. Precisely form characters with welded returns; welds shall be ground smooth and continuous.
  - b. Characters shall be flat with sharp defined corners; free of warps, distortions or other surface imperfections.
  - c. Material:
    - 1) Aluminum Sheet: ASTM B209 in alloy and temper as recommended by dimensional character manufacturer.
      - (a) Character Face Thickness: 0.09 inch, minimum.
      - (b) Character Return Thickness: 0.063 inch, minimum.
  - d. Character Styles (Fonts): As indicated.
  - e. Character Sizes: As indicated.
  - f. Character Return/Depths: As indicated.
  - g. Finish: Clear anodized.
  - h. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide fasteners as applicable for substrates indicated.
    - 1) Projected Mounting: Mount dimensional characters 1 inch off the substrate; from face of substrate to back of dimensional character.
    - 2) At exterior locations, provide stainless steel fasteners and hardware.

## 2.4 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.
  - 1. Acrylic, foam carrier, pressure-sensitive tapes with release liner for permanent bonding.
    - a. Products:
      - 1) 3M; VHB Tapes: [www.3M.com](http://www.3M.com).
        - (a) Provide specific VHB tape as recommended by tape manufacturer for applicable substrates.
      - 2) Substitutions: See Section 012500 - Product Requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION



- A. Verify that substrate surfaces are ready to receive work.

### 3.2 INSTALLATION

- A. General:
  - 1. Install in accordance with manufacturer's instructions.
  - 2. Install neatly, with horizontal edges level.
- B. Room and Door Signs:
  - 1. Mounting Locations: Unless otherwise indicated, mount signs as follows:
    - a. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- C. Dimensional Characters:
  - 1. Mount dimensional characters at heights and locations indicated; with characters equally spaced unless otherwise indicated.
- D. Plaques:
  - 1. Mount plaques at heights and locations indicated.

### 3.3 CLEANING AND PROTECTION

- A. Clean signage as recommended by signage manufacturer.
- B. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

## SECTION 102814 - ADULT CHANGING STATIONS

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. Adjustable-Height Adult-Changing Station

#### 1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough carpentry, blocking in walls.
- B. Section 092100 - Plaster and gypsum board assemblies, blocking in walls.
- C. Section 093000 - Tiling, coordination with tile layout and installation.
- D. Section 260000 - Electrical service installation.

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets for each product specified, including the following.
  - 1. Installation instructions and recommendations, including templates and rough-in measurements.
  - 2. Storage and handling requirements and recommendations.
  - 3. Cleaning and maintenance instructions.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide products manufactured by a company with a minimum of 5 years successful experience manufacturing similar products.
- B. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA, ICC A117.1 International Building Code (IBC), and state building code requirements as applicable.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

#### 1.6 WARRANTY

- A. Manufacturer's Warranties: Submit manufacturer's standard 3 year warranty for materials and workmanship.

### PART 2: PRODUCTS

## 2.1 MANUFACTURER

- A. Basis of Design Products: Koala Care, Inc: KB3000-AHL Adjustable Height Changing Station
- B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. See Section 012500 - Product Requirements.

## 2.2 ADULT CHANGING STATIONS, HEIGHT-ADJUSTABLE

- A. Surface-Mounted Adjustable Height Changing Station :
  - 1. Basis of Design: Model KB3000-AHL as manufactured by Koala Kare Products, a Division of Bobrick.
  - 2. Powered-Height Adjustability: Changing surface shall electronically adjust from 12" (300mm) to 41" (1,041mm) from floor.
  - 3. Unit shall have two sets of built-in electronic controls for height adjustment. One located on face of wall cover and one on the front of changing surface.
  - 4. Weight Capacity: Tested to support up to 500 lbs. (227 kg.) static load.
  - 5. Changing Surface shall be polyethylene and meet IK10 standard for resistance to high impact and sharp objects.
  - 6. Back-Up Battery: Unit shall have a built-in backup battery system that allows for continuous operation in the event of a power interruption.
  - 7. Emergency Stop: Unit shall include a wall-mounted emergency stop to break power to actuator.
  - 8. Changing Surface shall be a minimum 75 ¼" (1,911mm) long, and 31 ½" (800mm) wide, and can be opened and closed with one-hand.
  - 9. Unit shall have a safety rail with a curved dip in the center for easier patient changing by caregiver. Safety rail rotates and locks under changing bed when in closed position.
  - 10. Unit shall withstand significant exposure to water without damage to electrical components. It shall include a grounded power cord and have a splash-proof control system. Electrical components and wiring shall not come in contact with station users or caregivers.
  - 11. Changing surface shall not have covered areas to help ensure cleanliness.
  - 12. Unit shall have ISO 60601-1 and -2 whole product certification.
  - 13. Durability: Cycle tested through range of motion 28,000 times at 500lbs. Stress tested to 100,000 cycles with 500lbs. bounce load test.
  - 14. Frame shall be constructed of 2" powder coated steel tubing.

## PART 3: EXECUTION

### 3.1 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
  - 1. Verify wall blocking has been installed properly.
  - 2. Verify required electrical services have been installed properly.
  - 3. Verify wall location does not interfere with door swings or use of fixtures.
  - 4. Use fasteners and anchors suitable for wall substrate and project conditions.

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5. Install units at location and height indicated on the drawings.
6. Install units level, plumb, and in proper relationship with adjacent construction.
7. Adjust for proper operation.

### 3.2 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION

## SECTION 102113 - PLASTIC TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-plastic toilet compartments and urinal screens.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

#### 2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Basis-of-Design Product: Global Partitions Corp, an ASI Group Company; Solid Plastic (HDPE).
  - 2. Substitutions: See Section 012500 - Product Requirements.
- B. Toilet-Enclosure Style: Floor anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
- E. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- G. Panel Finish:
  - 1. Color and Pattern: As indicated on Drawings.

#### 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.
  - 1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  - 2. Provide continuous piano hinge at all door panels.

- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Door Size and Swings: 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 designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch (13 mm).
    - b. Panels and Walls: 1 inch (25 mm).
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

## SECTION 102123 - CUBICLE CURTAINS AND TRACK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Cubicle-curtain tracks and carriers.
  - 2. Cubicle curtains.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:
  - 1. Laundering: Launderable to a water temperature of not less than 160 deg F.
  - 2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
    - a. Identify fabrics with appropriate markings of a qualified testing agency.

#### 2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following Basis of Design product or an architect-approved equal. Substitutions: See Section 012500 - Product Requirements:
  - 1. Imperial Fastener Company
    - 1) IFC-98 clear satin anodized aluminum.
- B. Extruded-Aluminum Curtain Track: Not less than 1-3/8 inches wide by 3/4 inch high.
  - 1. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.
  - 2. Finish: White.
- C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
  - 1. End Stop: Removable with carrier hook.
- D. Curtain Roller Carriers: Two nylon rollers and nylon axle with nylon hook.

- E. Curtain Glide Carriers: One-piece nylon glide with nylon hook.
- F. Breakaway Curtain Carriers: One-piece nylon breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 5 lbf (22.2 N).
- G. Exposed Fasteners: Stainless steel.
- H. Concealed Fasteners: Stainless steel.

## 2.3 CURTAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following Basis of Design product or an architect-approved equal. Substitutions: See Section 012500 - Product Requirements:
  - 1. Imperial Fastener Company
- B. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
  - 1. Pattern: Maharam Sidestep 511460 with Nanotex antimicrobial finish.
  - 2. Color: to be selected from manufacturer's full range.
- C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.
- D. Mesh Top: Not less than 20-inch high mesh top.
  - 1. Mesh: No. 50 nylon mesh.
- E. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.
- F. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

## 2.4 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
  - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches of added fullness.
  - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.
  - B. For tracks of up to 20 feet in length, provide track fabricated from single, continuous length.
    - 1. Curtain-Track Mounting: Surface.
  - C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
    - 1. Provide one hinged loading unit for each bed.
  - D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.
  - E. Cubicle Curtains: Hang curtains on each curtain track. Secure with curtain tieback.
- END OF SECTION 102123



## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

#### 2.2 MANUFACTURERS

- A. Basis-of-Design Products: The design for toilet and bath accessories described in Part 2 are based on products as manufactured by American Specialties, Inc. Subject to compliance with requirements, provide the named product or comparable product by one of the following:
  - 1. Toilet and Bath Accessories:
    - a. A & J Washroom Accessories, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. General Accessory Manufacturing Co. (GAMCO).
    - e. Tubular Specialties Manufacturing, Inc
    - f. Substitutions: See Section 012500 - Product Requirements.

## 2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 366/A 366M, 0.0359-inch (0.9-mm) minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- E. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
- H. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## 2.4 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser.
  - 1. Owner furnished and Contractor installed.
- B. Paper Towel (Roll) Dispenser
  - 1. Owner furnished and Contractor installed.
- C. Liquid Soap Dispenser (at wall mounted lavatories):
  - 1. Owner furnished and Contractor installed.
- D. Grab Bar:
  - 1. Basis-of-Design: American Specialties, Inc., 3800 series, straight grab bar.
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
  - 4. Outside Diameter: 1-1/2 inches (38 mm).
  - 5. Configuration and Length: As indicated on Drawings.
- E. Sanitary-Napkin Disposal Unit:
  - 1. Owner furnished and Contractor installed.
- F. Mirrors
  - 1. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.
  - 2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
  - 3. Size: As indicated on Drawings.

## 2.5 FABRICATION

- A. 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.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

END OF SECTION 102800

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fire-protection cabinets for portable fire extinguishers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

#### 2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. J.L. Industries, Inc., a division of Activar Construction Products Group.
    - b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
    - c. Larsen's Manufacturing Company.
    - d. Modern Metal Products, Division of Technico Inc.
    - e. Potter Roemer LLC.
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Recessed Cabinet:
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semi-Recessed Cabinet (used only where wall depth does not allow a fully recessed cabinet.)
  - 1. Exposed Flat 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: 2-1/2 inch backbend depth.

- F. Surface Mounted Cabinet (used only where mounting to an existing wall that does not allow a Semi-Recessed Cabinet)
  - 1. Exposed Cabinet: Steel Sheet metal.
- G. Cabinet Trim Material: Steel sheet.
- H. Door Material: Steel sheet.
- I. Door Style: Fully glazed panel with frame.
- J. Door Glazing: Tempered float glass (clear).
- K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- L. Materials:
  - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
    - a. Finish: Baked enamel or powder coat.
    - b. Color: As selected by Architect from full range of industry colors and color densities.
  - 2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.3 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 backed-enamel finish.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architects.
  - 1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
    - a. Application Process: Vinyl letters.
    - b. Lettering Color: Red.
    - c. Orientation: Horizontal.

## 2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.4 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Six years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

#### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International Ltd.
    - c. Badger Fire Protection; a Kidde company.
    - d. J.L. Industries, Inc.; a division of Activar Construction Products Group.
    - e. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
    - f. Larsen's Manufacturing Company.
    - g. Potter Roemer LLC.
    - h. Pyro-Chem; Tyco Safety Products.
    - i. Substitutions: See Section 012500 - Product Requirements.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type MP: UL-rated 4-A:60-B:C, 10-lb (4.5 kg) nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- C. Wet-Chemical Type K: UL-rated K; 1.6-gallon nominal capacity, with potassium-acetate based chemical in manufacturer's standard enameled container.

## 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated black baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
  1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Horizontal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

## SECTION 105129 - PHENOLIC LOCKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Solid phenolic lockers.
2. Solid phenolic benches.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for concealed wood support furring and blocking behind lockers.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and locker bench.

B. Shop Drawings: For phenolic lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of cutouts and holes for items installed in lockers.
3. Show locker fillers, trim, base, sloping tops, and accessories.
4. Show locker identification system and numbering sequence.

C. Samples for Initial Selection: For each type of locker.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Phenolic panels, not less than 3 by 3 inches, for each type, color, pattern, and surface finish.
2. Exposed locker hardware and accessories, one unit for each type and finish.



1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms.
  - 1. Include manufacturer's written instructions for periodic cleaning and maintenance of each component.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Locker doors, complete with specified door hardware. Furnish no fewer than five doors of each type and color installed.
  - 2. Units of the following locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
    - a. Hinges.
    - b. Hasps.
    - c. Hooks.

1.7 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical corner, including one locker on each side of corner and corner filler, as indicated on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store lockers in manufacturer's original unopened packaging until ready for installation.
- B. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the

same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

- C. Deliver End-User manual to Owner by registered mail or overnight package service.

- 1. Refer to section 01 1000 "Summary" for owner address.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 45-60 percent during remainder of the construction period.
- B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 "Door Hardware" to fabricator of lockers; coordinate Shop Drawings and fabrication with hardware requirements.

#### 1.11 SEQUENCING

- A. Supply lockers to affected trades in time to avoid interruption of the construction process.
- B. Provide location templates and other information required for locker installation to affected trades in time to prevent interruption of the construction process.

#### 1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace phenolic locker components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Accessibility Requirements: Comply with requirements of the ADA and of authorities having jurisdiction.

### 2.2 PHENOLIC LOCKERS

- A. Product: LKR-1
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Storage Solutions; an ASI Group company; Phenolic Traditional Collection Lockers or comparable product by one of the following:
  - 2. Bobrick Washroom Equipment, Inc.
  - 3. Bradley Corporation.
  - 4. Substitutions refer to section 012500
- B. Construction Style: Manufacturer's standard means of factory assembly with machined joints, pins, and tamper-resistant mechanical fasteners.
- C. Configuration: Single tier.
- D. Body: Fabricated from solid phenolic panels.
  - 1. Side Panels: 1/2 inch thick.
  - 2. Back Panel: 1/2 inch thick.
  - 3. Top Panel: 1/2 inch thick.
  - 4. Bottom Panel: 1/2 inch thick.
  - 5. Shelves: 1/2 inch thick.
- E. Doors: 1/2-inch thick, solid phenolic panel, fabricated to full width of locker; frameless with perimeter ventilation.
- F. End Panels: 1/2-inch thick, solid phenolic panel matching doors.
- G. Continuous Sloping Tops: 1/2-inch thick, solid phenolic panel matching doors; include manufacturer's standard aluminum front- and rear-support brackets with black powder-coated finish.
- H. Color: As selected by Architect from manufacturer's full range.
  - 1. Edge (Core) Color: Black.

## 2.3 MATERIALS

- A. Phenolic Panels: Solid phenolic with selected high-pressure melamine matte finish as an integral part of core material. Laminated surfaces are unacceptable.

## 2.4 HARDWARE

- A. Recessed Door Handle and Latch: Manufacturer's standard; black HDPE plastic cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
  - 1. Single-Point Latching: Nonmoving latch hook with steel padlock hasp projecting through recessed cup.
    - a. Latch Hook: Equip each door with manufacturer's standard latch hook, mounted midway up each door.
- B. Hinges: Manufacturer's standard; steel with black, powder-coated finish, to allow door to open 120 degrees.
- C. Identification Plates: Manufacturer's standard; etched, embossed, or stamped aluminum plates, with black numbers at least 1/2 inch high.
- D. Hooks: Manufacturer's standard; ball-pointed, zinc-plated steel hooks.
- E. Coat Rods: Manufacturer's standard.

## 2.5 LOCKER BENCHES

- A. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 17.25 inches measured from top of bench to floor, as follows:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Storage Solutions; an ASI Group company; Hardwood Locker Benches or comparable product.
  - 2. Steel Tube Pedestals: 16-1/4 inches high, 1-1/2-inch diameter powder-coated steel tubing with 8-inch diameter flanges with three mounting holes at each end.
    - a. Color: As selected by Architect from manufacturer's full range.
  - 3. Bench Tops: 1-1/4-inch thick, lacquered hardwood.
    - a. Color: As selected by Architect from manufacturer's full range.
    - b. Width: 24 inches.
    - c. Length: 42 inches

## 2.6 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
  - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Wood Support Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber kiln-dried to less than 15 percent moisture content, treated with manufacturer's standard preservative-treatment process, as specified in Section 061000 "Rough Carpentry."

## 2.7 FABRICATION

- A. Fabricate and supply factory preassembled lockers, complete with hardware and accessories.
- B. Fabricate each locker with shelves; a single door and frame; and a single top, bottom, and back; and with common intermediate uprights separating compartments.
  - 1. Fabricate lockers to dimensions, profiles, and details indicated.
- C. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of scratches, and chips. Factory machine components to suit attachments. Make joints tight and true.
  - 1. Fabricate lockers using manufacturer's standard mortise and tenon construction.
  - 2. Provide slope tops and end panels as required to complete installation as indicated on Drawings.
- D. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf minimum 15 inches above finished floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate maximum 48 inches above finished floor.
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. 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 fabrication shop unable to be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices removable after trial fitting. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

2. Use only locker manufacturer's brackets, nuts, bolts, screws, and other anchoring devices for assembly.
- F. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that furring is attached to concrete and masonry walls receiving lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Condition lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.
- C. Thoroughly clean surfaces prior to installation.

#### 3.3 INSTALLATION

- A. Install lockers in accordance with manufacturer's written instructions.
  - B. Install lockers level, plumb, and true; use concealed shims.
  - C. Connect groups of lockers together with manufacturer's standard stainless steel, theft-proof fasteners, through predrilled holes in locker interior. Fit lockers accurately together to form flush, tight, hairline joints.
  - D. Install lockers without distortion for doors and drawers to fit and align with openings. Adjust hardware to center doors and drawers in openings, and provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Installation Tolerance: Maximum 1/8- in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

- E. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with anchoring devices furnished, and spaced not more than 16 inches o.c.
- F. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- G. Attach sloping-top units to lockers, with end panels covering exposed ends.
- H. Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 60 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

#### 3.4 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

#### 3.5 PROTECTION

- A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Clean exposed surfaces of lockers and hardware.
- C. Touch up marred finishes to factory-finished appearance, or replace unrestorable lockers. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105129

## SECTION 11 67 33 - CLIMBING WALL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Climbing wall system components of the following types:
  - 1. Climbing walls.
  - 2. Hand holds.
  - 3. Mat locking system and safety mats.
  - 4. Climbing wall accessories.

#### 1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 05 50 00 - Metal Fabrications.
- C. Section 06 10 00 - Rough Carpentry.
- D. Section 09 29 00 - Gypsum Board Wall Assemblies.

#### 1.3 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials within the Use Zone of Playground Equipment.
  - 3. ASTM F2440 - Standard Specification for Indoor Wall/Feature Padding.
- B. Climbing Wall Association (CWA).
  - 1. CWA Standards for the Design and Engineering of Manufactured Climbing Structures.
- C. National Fire Protection Association (NFPA):
  - 1. NFPA 286 - Standard Methods of Fire Tests for Evaluation Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

#### 1.4 DEFINITIONS

- A. Artificial Climbing Wall: A wall with indentations, overhand, roofs or other projections such as hand holds, or foot holds used for rock climbing.
- B. Surfacing: The patent-pending substrate with aggregate that provides durable and texture while allowing the wood or colored stain to show through to create visual appeal.
- C. Route: Surface for climbing that is approximately four to five feet wide, extending vertically from the floor.
- D. Anchor Point: The location on the climbing wall where anchors are placed that are used to belay climbers during their climb.
- E. Top Rope Climbing Route: Climbing routes which have anchor points at the top of the wall that support the climber via rope that is held by a belayer on the floor



below the climber. The anchor point is always located above the climber.

- F. Lead Climbing Route: Climbing routes which have anchor points throughout the wall that support the climber via rope that is held by a belayer on the floor below the climber. The anchor point may sometime be located below the climber until the climber ascends above that anchor point and connects to another anchor point.

## 1.5 SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's data sheets on each product to be used.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Typical installation methods.
- B. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.
- C. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
  - 1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
  - 2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
  - 3. Retain mock-up during construction as a standard for comparison with completed work.
  - 4. Do not alter or remove mock-up until work is completed or removal is authorized.

## 1.7 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

#### 1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### 1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

#### 1.11 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard limited warranty.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Everlast Climbing
- B. Substitutions: Refer to section 012500.

#### 2.2 CLIMBING WALLS

- A. Adaptive Wall: Basis of Design: Adaptive Wall; as manufactured by Everlast Climbing.
  - 1. Description: White, dry-erase, magnet-accepting surface with adaptive hand and foot holds.
  - 2. Wall Height: 8 feet (2438 mm).
    - a. Panels: 4 x 8 foot (1219 x 2438 mm) panels.
    - b. Length: 20 feet (6096 mm).
    - c. Length: 40 feet (12192 mm).
    - d. Length: \_\_\_\_\_.
    - e. Hand Holds: Groperz Route-Setting Hand Holds.
      - 1) Colors: Red, Yellow, and Green.
      - 2) Quantity: 20 per panel.
    - f. Adaptive Holds: 4 hand holds and 2 ledge foot holds per panel.
    - g. T-Nuts: 66 per panel for mounting hand holds.
    - h. Cordless Mat Locking System and Safety Mat: 1 per panel.
  - 3. Additional Components:
    - a. Relief Line: Red-Relief Line: A safety feature that reminds climbers to stay within a distance of three feet from the floor and acts as helpful tool for climbing wall supervisor.
    - b. Safety, care, and maintenance manual.
    - c. Rules and guidelines sign.
    - d. Activity Wall Activity guide.
    - e. Magnets: Number, letter, and sentence-building magnets.
    - f. Dry-erase markers.

## 2.3 HAND HOLDS

- A. Beginner Hand Holds: Basis of Design: Beginner Route Setting Hand Holds; as manufactured by Everlast Climbing.
  - 1. Description: Large, easy to grab designs.
  - 2. Set A: Set of 10 hand holds.
  - 3. Set B: Set of 10 hand holds.
  - 4. Set C: Set of 10 hand holds.
  - 5. Set D: Set of 10 hand holds.
  - 6. Color: Green.
  - 7. Includes mounting hardware and Allen wrench.
  - 8. Includes mounting hardware

## 2.4 MAT LOCKING SYSTEM AND SAFETY MATS

- A. Cordless Mat Locking System: Hook and loop fastening system with security slider and lock.
  - 1. Two nylon-webbing loops attached to each mat.
  - 2. Security latch system attaches to wall.
  - 3. Two highly durable thermal plastic coated tabs attach to each mat and connect to base of the wall.
  - 4. Hook and loop fastening system with security slider and lock.
    - a. Two nylon-webbing loops attached to each mat.
    - b. Security latch system attaches to wall.
    - c. Two highly durable thermal plastic-coated tabs attach to each mat and connect to base of the wall.
  - 5. Side Locks: Hook and loop flaps secure mats side-by-side. Locks each end of system to prevent climbing in between the mats and the closed climbing wall.
- B. Standard Mats: Basis of Design: Standard Mats; as manufactured by Everlast Climbing.
  - 1. Description: Polyethylene foam enclosed in an 18-ounce (0.51 kg) polyester-reinforced vinyl cover.
  - 2. Hook and loop fastening system with security slider and lock.
    - a. Two nylon-webbing loops attached to each mat.
    - b. Security latch system attaches to wall.
    - c. Two highly durable thermal plastic-coated tabs attach to each mat and connect to base of the wall.
  - 3. Side Locks: Hook and loop flaps secure mats side-by-side. Locks each end of system to prevent climbing in between the mats and the closed climbing wall.
  - 4. Compliant with ASTM F2440 and ASTM F1292.
  - 5. Color: Custom color, to be selected by Architect.
  - 6. Thickness: 3 inches (76 mm).

## 2.5 CLIMBING WALL ACCESSORIES

- A. Outlet Frames: Surrounds outlets to make them aesthetic and functional parts of the climbing wall.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.
- B. Completed wall shall comply with specified tolerances.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.
- B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

### 3.5 TRAINING

- A. Provide full day training session for the facility operations staff, following the climbing wall installation. Training shall cover the following topics:
  - 1. Climbing wall maintenance and periodic inspections.
  - 2. Route-setting methods and management.
  - 3. Sample handhold installation and removal.

### 3.6 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturers recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 117300 - PATIENT CARE EQUIPMENT

### 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. Ceiling-mounted patient-lift systems.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for above-ceiling supplementary framing for support and anchorage of patient-lift systems.
  - 2. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.
  - 3. Section 102123 "Cubicle Curtains and Tracks" for patient-room cubicles.
  - 4. Section 102800 "Toilet, Bath, and Laundry Accessories" for specimen pass-through cabinets and boxes and for bedpan and urinal cabinets and boxes.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of components. Indicate location and size of each field connection.
  - 3. Include diagrams for service connections and power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long in size.
- D. Samples for Initial Selection: For each type of exposed finish.

1. Include Samples of accessories involving color and finish selection.
- E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:
  1. Include Samples of accessories to verify color and finish selection.
  2. Ceiling-Mounted Patient-Lift Systems: Not less than 10-inch long, track sections.
- F. Delegated-Design Submittal: For above-ceiling supplementary framing for support and anchorage of patient-lift systems, signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For ceiling-mounted patient-lift systems, reflected ceiling plan(s), and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Suspended ceiling components.
  2. Structural members to which ceiling-mounted patient-lift systems will be attached.
  3. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Sprinklers.
    - d. Access panels.
  4. Perimeter moldings.
- B. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For products to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design above-ceiling supplementary framing for support and anchorage of patient-lift systems.

## 2.2 CEILING-MOUNTED PATIENT-LIFT SYSTEMS

- A. Ceiling-Mounted Patient Lift: Consisting of a motor-driven lift unit that traverses on a ceiling-mounted track system.
  - 1. Basis of Design Manufacturer: Amico Group of Companies, [www.amico.com](http://www.amico.com)
- B. Ceiling-Mounted Track System: High-strength extruded aluminum in manufacturer's standard profile and thickness to support lifting capacity indicated for lift unit. Provide track shapes and accessories as required to provide a complete system in layout indicated on Drawings.
- C. Lift Unit: Steel frame system with separate 24-V dc lifting and horizontal-drive motors secured to chassis.
  - 1. Lifting Capacity: 440 lb.
  - 2. Maximum Lift Range: 96 inches.
  - 3. Safety Features:
    - a. Emergency stop.
    - b. Emergency lowering device, mechanical and electrical.
    - c. Control of lift strap.
    - d. Cut-off Angle: 45 degrees along the rail; 10 degrees across the rail.
  - 4. Electronics:
    - a. Control Unit: Walk-along, hand-held control unit.
    - b. On/Off Control: Soft start and stop with overload protection.
    - c. Battery Power: 24-V rechargeable nickel-metal hydride batteries in quantity required for lifting capacity indicated. Provide with electric battery charging station that provides maximum charge time of two hours per battery.
      - 1) Provide wall-mounted charging station at end of track. Provide supplemental clip-on charging station with indicator lights.
    - d. Battery Protection: Low-battery light illuminates when battery voltage is below 22 V; hoist disabled when battery voltage is below 20 V.
    - e. Motors: Provide in quantity required by lifting capacity indicated.
      - 1) Lift Motors: 2.3 inches per second lift speed at maximum capacity load.
      - 2) Horizontal-Drive Motors: 5.9 inches per second horizontal traverse at maximum capacity load.
- D. Accessories:
  - 1. Bariatric carry bar.

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CEILING-MOUNTED PATIENT-LIFT SYSTEMS

- A. Install tracks level and plumb, according to manufacturer's written instructions.
  - 1. Support track directly from structure using manufacturer's standard supports, anchors, and fasteners at intervals required by lifting capacity indicated, but not less than 36 inches o.c.
  - 2. Brace direct-to-structure track supports where distance between suspended ceiling and anchors is more than 18 inches.
  - 3. Provide supports at each track end, splice, and tangent point of each corner.
  - 4. Install track accessories, splices, end caps, connectors, coupling and joining devices, and other accessories as required for a secure and operational installation.

### 3.3 ADJUSTING

- A. Adjust products for proper function and operation to comply with manufacturer's written instructions.

### 3.4 PROTECTION

- A. Protect installed products from damage for the remainder of the construction period.
- B. Repair damaged products according to manufacturer's written instructions. If damaged products cannot be successfully repaired, as determined by Architect, remove and replace damaged products.

END OF SECTION 117300



## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Manually operated roller shades with single rollers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Selection Samples: For each finish product specified, provide two (2) samples representing manufacturer's full range of available colors, materials and patterns.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Warranty documentation.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm certified by Manufacturer to install specified products.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty and as follows:
  - 1. Hardware and Shade Fabric: Provide ten (10) year limited warranty.
  - 2. Roller Shade Components: Manufacturer's limited lifetime warranty against defects in materials and workmanship.
  - 3. Roller Shade Installation: One year from date of Substantial Completion.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

### 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products as manufactured by Mecho Shade Systems, Inc. as the Basis-of-Design.
- B. Equal products as manufactured by one of the following are also acceptable:
1. Draper Inc.
  2. Hunter Douglas Contract
  3. Legrand (Solarfactive).
  4. Levolor
  5. Lutron Electronics Co., Inc.
  6. Substitutions: See Section 01 6000 - Product Requirements.
- C. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Chain-Retainer Type: Chain tensioner, jamb mounted.
  2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- D. Access and Material Requirements:
1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
  2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
  3. Provide all shade installation hardware allowing for installation and removal of the shade without requiring the removal of hardware.
    - a. Brackets to be constructed of minimum 0.07 inch thick painted or nickel-plated, C1008/1010 cold rolled steel.
    - b. Painted brackets shall be finished with high quality baked enamel coating.
    - c. End plug bracket shall have a spring locking retainer device.
    - d. Brackets shall be reversible for right- or left-hand installation.
- E. Manual Operated Chain Drive Hardware and Brackets:
1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
  2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
  3. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
  4. Control system shall be constructed of fiberglass reinforced polyester thermos-polymer (PBT) resin, aluminum.
  5. Internal springs shall be constructed of tempered high carbon steel for smooth, trouble-free operation, precise control.
  6. Clutch shall develop no more than 1/2 pound drag for easy lift.
  7. System to be symmetrical for left or right hand installation.

8. Drive Chain: #10 qualified stainless-steel chain rated to 90 lbs. (41 kg) minimum breaking strength.

## 2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric for all areas unless noted otherwise:
  1. MechoShade: SoHo 1600 Series
  2. Color: As selected by Architect from manufacturer's full range.
  3. Material Openness Factor: 3%.
  4. Orientation on Shadeband: Up the bolt.

## 2.4 SHADE BAND

- A. Shade Bands: Construction of shade bands includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade to the roller tube. Sewn hems and open hem pockets are not acceptable.
  1. Hem Pockets and Hem Weights: Fabric hem pocket with welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
  2. Shade band and Shade Roller Attachment
    - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades are not acceptable.
    - b. Provide for positive mechanical engagement with drive / brake mechanism.
    - c. Provide for positive mechanical attachment of shade band to roller tube.

## 2.5 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
  1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
  2. Outside of Jamb Installation: Width and length as required, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
  1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
  2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

- D. Fabricate shade cloth to hand flat without buckling, distortion, waves, cupping, or wraps. Shade edges shall not fray, curl or unravel. Fabricate hem as follows:
  - 1. Standard Bottom Bar: Concealed heat seamed fabric, rolled over an aluminum bar.

## 2.6 ACCESSORIES

- A. Fascia:
  - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
  - 2. Fascia shall be able to be installed across two (2) or more shade bands in one piece.
  - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
  - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
  - 5. Notching of Fascia for manual chain shall not be acceptable.
    - a. Color: Selected from manufacturer's standard colors.

## PART 3 - EXECUTION

### 3.1 PROJECT CONDITIONS

- A. Comply with Environmental Requirements as follows:
  - 1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
  - 2. Install window treatments after finish Work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

### 3.2 EXAMINATION

- A. Carefully examine installation areas with Installer present, for compliance with requirements affecting Work performance.
  - 1. Verification of Conditions: Verify that field measurements, surfaces, substrates, structural support, utility connections, tolerances, levelness, plumbness, humidity, moisture content level, cleanliness and other conditions are as required by the manufacturer, and ready to receive Work.
    - a. Verify each roller shade assembly will fit within its corresponding window shade pocket. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.
- E. Perform required Demonstration and Training with Owner's designated staff.
  - 1. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

END OF SECTION 122413

SECTION 22 05 00  
PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SPECIFICATIONS AND DOCUMENTS

- A. Drawings and related specifications for this project including General and Supplementary Conditions, Division 1, General Requirements, Instructions to Bidders, Addenda's, etc. apply to and are considered a part of Division 22 - Mechanical Work.
- B. Information in this division is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions, and Division I of these specifications. Any conflict between this Division 22 and other sections or divisions of the specifications or drawings shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.
- C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor, materials, equipment and incidentals necessary for their complete installation and operation.
- D. All information contained in this section applies to all sections within Division 22 as if it was part of each section.

1.2 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are intended to supplement each other and any material or labor called for in one shall be furnished even if not specifically mentioned in both. Any material or labor which is neither shown on the drawings nor listed in this specification, but is normally incurred or required for completion of work shall be furnished. If there is a discrepancy between the drawings and specifications, the more stringent of the two shall be followed.
- B. Drawings are diagrammatic and are intended to show approximate location and general arrangement of systems and equipment. No attempt has been made to show every ell, tee, etc. Drawings shall not be scaled for location of systems, equipment, etc. All dimensions whether given on drawings or scaled shall be verified in field and coordinated with all other trades and existing field conditions. Some plumbing, piping, equipment, etc. locations may require changes in location due to field conditions and coordination with other trades will be made with no additional cost to the Owner. Failure to check will be no reason for additional compensation.
- C. These drawings and the associated specifications are intended to provide complete furnishing, installation and operational plumbing systems as specified under Division 22 and as called for on the drawings. If these drawings and associated specifications have information omitted that would not allow a completely operational system as is the intent of the Engineer, the bidder shall notify the Engineer a minimum one week prior to the bid date to allow for addenda. Once bids have been received, the Contractor shall be responsible for material, labor, etc., to furnish and install a completely operational plumbing system as is the intent of these drawings and associated specification.

- D. The installation of all systems, equipment, etc., is subject to clarification with submitted shop drawings and field coordination requirements. Equipment outlines shown on drawings or dimensioned on drawings are limiting dimensions. Any equipment that reduces the indicated clearances or exceeds specified or scheduled equipment dimensions shall not be used.
- E. The Architect/Engineer and Owner reserve the right to make minor changes in the location of equipment, piping, ductwork, etc. at the time of rough-in without additional cost to the Owner.
- F. The Mechanical Trades Contractor shall have completed for his portion of work, at least one installation of size and type comparable to this project and has been in satisfactory operation for at least two complete years. The Mechanical Trades Contractor shall also have a developed service department capable of negotiating service contracts with the Owner for systems herein specified.

### 1.3 AUTOCAD BACKGROUND FILES

- A. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

### 1.4 MANUFACTURER'S SPECIFICATIONS AND CAPACITIES

- A. Some equipment, plumbing fixtures, materials, etc. that are scheduled on the drawings or listed in any addenda may not be specified in this specification. The manufacturer's specification and capacities shall be considered included and part of this specification whether it is specified in this specification or noted or scheduled on the drawings. The contractor shall remove and replace any "substituted" equipment or material, which has been installed or is on site, which in the opinion of the Architect/Engineer does not meet the scheduled equipment or materials, manufacturer's capacities or specification at no additional cost to the Owner.

### 1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in pipe shafts.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.6 LOCAL CONDITIONS

- A. Before submitting proposals, each contractor shall examine these specifications and associated drawings, addenda, etc. and shall examine the site of the project. The bidder shall fully investigate the site of this project, investigate coordination of his work with all other trades and existing conditions and completely satisfy himself as to the conditions to which the work is to be performed before submitting his/her bid. No allowances or considerations will be given at a later date for alleged misunderstanding as to the requirements of the work, materials to be furnished, or conditions required by the nature of this project site and coordination by the neglect on the bidder's part to make such an examination and coordination.
- B. Drawings show approximate location of existing services. The mechanical and electrical trades shall check with local utility companies or municipal agencies for exact location of services which they expect to encounter. The Mechanical Trades Contractor shall be responsible for hiring a company such as "Miss Dig" to stake out and locate all utilities in areas of excavation before commencing any work. The Mechanical Trades Contractor shall verify all elevations and locations of existing underground lines which are to be connected into or routed over or under. This verification shall be done prior to beginning work at this project.

#### 1.7 QUALITY ASSURANCE

- A. All work shall be performed in accordance with all local and state codes, laws and regulations applicable to the work for this project. The contractor shall be responsible for all permits and costs for inspections, etc., and for checking with each utility company supplying service to this project and shall determine from them all, any changes in boxes, meters, valves, service, etc., and shall include all cost for inspections, revisions to services, etc. in his bid as required by local agencies, utilities, etc. No extra payment will be made for such items after the contractor submits his bid.
- B. In addition to all applicable Federal, State and local codes, the standards and codes listed below shall apply to all mechanical work. The reference to codes and standards shall be referenced to the latest edition or revision.
  - 1. American Gas Association (AGA)
  - 2. American National Standard Institute (ANSI)
  - 3. American Society of Mechanical Engineers (ASME)



4. American Society for Testing materials (ASTM)
5. American Water Works Association (AWWA)
6. American Welding Society
7. ANSI code of Pressure Piping and Unified Pressure Vessels
8. Cast Iron Soil Pipe Institute
9. National Electrical Manufacturer's Association (NEMA)
10. Standards of the Hydraulic Institute
11. Underwriters' Laboratories (UL)
12. Williams-Steiger Occupational Safety & Health Act (OSHA)

- C. In the event of conflict between drawings, codes, standards or specifications, the most stringent requirement shall apply

#### 1.8 SUBMITTALS AND SHOP DRAWINGS

- A. Submit electronic sets of complete shop drawings for all plumbing equipment and materials associated with Division 22 and associated drawings to the Architect/Engineer for review before fabrication of work or ordering of equipment. Shop drawings shall be submitted at the earliest possible time.
- B. Shop drawings shall be first reviewed by the contractor. Inaccurate shop drawings shall be corrected by the contractor to meet specifications and schedules for this project. The contractor shall then initial the shop drawings as having been reviewed before submitting to the Architect/Engineer. Shop drawings shall have, in addition to the mechanical information, the electrical requirements for minimum circuit amperes and maximum fuse size ratings of the equipment.
- C. Drawings which are rejected must be corrected and returned for Architect/Engineer review before ordering.
- D. Furnish to the job site copies or prints of shop drawings that have been reviewed by the Engineer as soon as possible.
- E. Include a copy of each shop drawing in the Operation and Maintenance Manual.
- F. The checking and reviewing of shop drawings by the Architect/Engineer shall be construed as assisting the contractor and the Architect/Engineer's action does not relieve the contractor from the responsibility for errors or omissions which may exist thereon. The contractor shall be held responsible for errors or omissions that are discovered after approval process and must be made good by the contractor.

#### 1.9 PERMITS, INSPECTIONS AND TESTS

- A. The Mechanical Trades Contractor shall take out all permits and arrange for necessary inspections and shall pay all assessments, fees and costs, etc., and make all tests as required by applicable codes. At the completion of the project, the Mechanical Trades Contractor shall furnish certificates of inspection and approval and secure final occupancy permit. Record copies shall be included in the Operation and Maintenance manuals.

#### 1.10 RECORD DRAWINGS

- A. Maintain an up-to-date set of "record" drawings showing actual equipment, plumbing piping, etc. installation locations. Exact dimensions from column lines for all concealed work and tie-ins with elevations noted shall be included.
- B. Include a set of reproducible drawings and a set of prints in each Operation and Maintenance Manual.
- C. The Engineer reserves the right to request and be furnished any additional information he deems necessary to be shown on the record drawings.

1.11 OWNER'S INSTRUCTIONS

- A. Upon completion of the project, the contractor shall be responsible for instructing the Owner's operating staff, in the presence of the Architect/Engineer's representative, in the proper operation and maintenance of the mechanical systems and equipment. Include a statement signed by the Owner that instructions have been given for proper operation and maintenance of the mechanical systems and equipment.

1.12 GUARANTEES

- A. Furnish a written guarantee, to the Architect/Engineer, that will make the contractor responsible at his own expense for any imperfections in material and/or workmanship which may develop under ordinary use within a period of one (1) year from final Owner's acceptance of the work.
- B. Furnish all written guarantees from equipment and/or material manufacturers which shall include the operating and performance conditions and capabilities upon which they are based.

1.13 PORTABLE AND DETACHABLE PARTS

- A. Retain all portable and detachable parts of installation such as keys, spare accessories, operating manuals, etc. include in the Operation and Maintenance Manual.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. Furnish to the Architect/Engineer two (2) copies of an approved bound (3 ring binder) book with tabs for sections covering each item of equipment. These notebooks shall include shop drawings, maintenance manuals, operating manuals and parts lists to instruct the Owner on proper operation and use as well as maintenance for each piece of equipment. These books shall also include contractors', subcontractors' and manufacturers' names, telephone numbers and addresses.
- B. The manuals must be approved by the Architect/Engineer before final payment to the contractor. The Engineer reserves the right to request and be furnished any additional information that he deems necessary to be included in the manuals.

1.15 RESPONSIBILITIES FOR USE OF SUBSTITUTE MATERIALS

- A. Contractor shall notify Architect/Engineer in writing at least ten (10) calendar days before bids are due for approval to use materials and/or equipment other than that which has been specified or scheduled. If substitute materials and/or equipment are approved and

used, it will be this contractor's responsibility to guarantee that the items will function as the specified equipment or materials, will in no way alter the design of the structure or system, and will not require any additional mechanical work such as piping, plumbing, etc. Any additional cost required by substitute materials will be the responsibility of the contractor.

- B. It will be the contractor's responsibility, at his own expense, to remove or replace any non-approved equipment or material or any approved equipment or materials not originally specified or scheduled if equipment and materials do not meet with the satisfaction of the Architect/Engineer.
- C. It shall be the Contractor's (Mechanical Trades) responsibility to coordinate and pay for any Electrical Contractor costs due to any changes in substitute materials and/or equipment's power requirements, which differ from that shown on the design documents.
- D. No consideration will be given to requests for substitute materials because of delivery problems unless the contractor can prove that orders were placed as soon as possible after contract was awarded and that delays were not caused by submittal of unscheduled or unspecified (substituted) materials to the Architect/Engineer.

#### 1.16 COST BREAKDOWN AND EQUIPMENT LIST

- A. The successful bidder shall be responsible for submitting a cost breakdown to the Architect/Engineer and Owner within ten (10) calendar days after date of request of the breakdown. During progress of the work, if changes occur which cause additional cost, the price on such items shall be broken down in accordance with the items listed in the breakdown.
- B. The bidders shall be responsible for submitting a complete list of all equipment manufacturers, makes, models, etc. that will be used for this project with their proposal. The equipment list shall be typed on the contractor's letterhead and shall be signed by the authorized officer.

#### 1.17 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this project shall have a minimum warrantee of one (1) year. All materials and equipment shall be new, of first class quality and shall be furnished, delivered, erected, installed and finished in every detail and shall be so selected and arranged as to fit into the building space. All material or equipment that is not specified but necessary for this project shall be subject to the approval of the Architect/Engineer.
- B. Any materials or equipment not specified or scheduled but similar to that which has had prior approval shall be listed as a substitution and noted on the proposal form as such.
- C. The contractor shall include all miscellaneous materials and labor required to completely install and operate the plumbing systems as is intended by these drawings and specification.

#### 1.18 SCHEDULE, COORDINATION AND INSTALLATION OF WORK

- A. The contractor shall carry on work in such a manner as to meet the dates as scheduled by the General Contractor and shall work overtime at no expense to the Owner as required to comply with the schedule. This contractor shall schedule all work with Owner and Architect/Engineer and schedule shut down of systems with Owner.
- B. Examine the site and all drawings and specifications and coordinate work with all other trades before commencing work for this project. Arrange work essentially as shown with the exact layout to be made on the job to suit actual conditions. Precise locations of equipment and materials shall be coordinated and shall be the responsibility of this contractor. Should any conflicts in location occur, and necessary deviations from drawings are required as determined by the Architect/Engineer, the contractor shall make necessary adjustments without additional cost to the Owner.
- C. All equipment, plumbing piping, etc. shall be located and/or routed to allow for the most convenient access for servicing.
- D. Arrange for necessary access doors, panels, etc. to allow servicing of equipment, piping, valves, etc. Perform any cutting and patching as required, made necessary by failure to make proper arrangements.
- E. Indicated equipment connections, sizes and locations shall be verified and connected according to manufacturer's shop drawings and installation instructions. Thoroughly investigate the space provided for equipment and connections before ordering equipment. All equipment shall be selected to fit into the space allowed, including connections with adequate space allowed for operation and maintenance.
- F. All work shall be installed in a neat and workmanlike manner, using skilled personnel thoroughly qualified in the trade or duties that they are to perform. Rough work will be rejected.
- G. Coordinate all equipment deliveries and schedules to allow timely installation. Contractor shall separate equipment into sections and reassemble in building if required by the installation at no extra cost to the Owner.
- H. Furnish a superintendent approved by the Architect/Engineer to oversee and coordinate the work to be performed with all other trades.
- I. Coordinate location of pipes, plumbing, etc. with other building components such as structural components (beams, joists, columns, etc.), electrical components (lighting, conduits, etc.) and architectural components (walls, ceilings, floors, pipe chases, roof, etc.).
- J. Before starting work, Contractor shall verify that available space for proposed pipes, equipment etc. is adequate for the intended purpose and will result in a first class installation. Regardless of drawings, responsibility for first class operating systems rests with the Contractor.
- K. Arrange for chases, slots, openings, etc. and other building components to allow for plumbing systems installation. Coordinate cutting and patching of these components to accommodate installation. This contractor shall be responsible for accurately locating for the general trades all chases, shafts, etc. and shall be responsible for all cutting and patching if these chases were not accurate or not coordinated in time with the general

trades. Coordinate installation of all sleeves in walls, floors or other structural or architectural components.

- L. Sequence, coordinate and integrate installation of equipment and materials for efficient work flow during the project. Particular attention should be spent on larger pieces of equipment.
- M. Install equipment and materials with provisions for necessary access for service and maintenance. Allow space for removal of all parts that may require replacement or servicing.
- N. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- O. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. When access panels are required, valves and equipment components requiring access shall be located to minimize the number of panels.
- P. Examine the work as it progresses and alert the Architect/Engineer in writing of any instances or obstructions that will prevent this contractor from performing his/her work.
- Q. The Mechanical Trade shall be responsible for all coordination of all site utilities, the gas company, etc. including coordination of all new and existing natural gas loads.

#### 1.19 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.

#### 1.20 COOPERATION WITH ARCHITECT/ENGINEER AND OTHERS

- A. Coordinate all aspects of the plumbing system installation with all other trades, existing conditions, etc.
- B. If the bidder believes that changes in design are required to meet intended design capacities and operation or material and/or equipment is obviously omitted from these specifications and drawings, the bidder shall contact the Architect/Engineer in writing at least ten (10) days before bid date. The acceptance of a bid by the Owner shall be binding and shall indicate that the bidder does not require any changes in design nor additional costs in order to meet the design and performance of the mechanical system as indicated in these specifications and drawings.

#### 1.21 WORK INVOLVING OTHER TRADES

- A. Equipment or materials specified in Division 22 may have to be installed by other trades (such as electrical trades or architectural trades) due to code requirements or union jurisdictional requirements. Where this occurs, this contractor shall include all costs

required by other trades to complete the work and hire the respective trade to perform this work.

#### 1.22 PERFORMANCE DATA AND ACCESSIBILITY

- A. All performance data specified in this specification or scheduled on drawings shall be considered actual performance of the equipment after installation. The supplier and installer shall be responsible for suitable allowances to adjust equipment to design capacities when actual operating and installation conditions differ from drawings.
- B. All equipment and materials shall be installed to allow access for servicing and maintenance. Coordinate final location of such equipment and materials that are concealed with required access doors on panels. Allow ample space for replacement or servicing.

#### 1.23 CUTTING AND PATCHING

- A. Unless noted otherwise, the Mechanical Trades shall be responsible for all cutting, patching and associated work required under Division 22. This work shall be performed by trades normally performing this type of work except drilling of holes shall be done by the contractor requiring same. This includes replacing areas of cutting required by this work with proper reinforcing, termite shielding, materials, finishing, etc. to restore the areas to their original condition, and filling all openings around ducts, piping, etc. with approved fire retardant materials. Regardless, all drilling of holes shall be the responsibility of the Contractor requiring same.
- B. If noted on drawings that the General Trades will be responsible for all cutting and patching, it will be the Mechanical Trades responsibility to notify all General Trades during bidding of all areas requiring cutting and patching. Regardless, all drilling of holes shall be the responsibility of the contractor requiring same.

#### 1.24 WORK IN EXISTING BUILDINGS

- A. Coordinate and schedule all work in existing building with Owner and Architect/Engineer. Systems shall be kept in operation at all times if at all possible. If a system shut-down is required, the contractor shall schedule with the Owner, the time and length of shut-down. A system shall not be shut down without written permission from the Owner.
- B. All existing equipment, plumbing, piping, etc. that is to be removed shall remain the property of the Owner. The contractor shall remove and locate this material that remains the property of the Owner to a location determined by the Owner somewhere on site. If the Owner does not want to maintain possession of the removed material, the contractor shall be responsible for removing material from the site and disposing of this material as necessary to meet all codes and requirements and shall pay all costs as required for any disposal fees, inspections, permits, etc.
- C. All existing piping, equipment, etc. whether shown on drawings or not that is to be removed and/or abandoned and does not remain property of the Owner shall be removed from site.
- D. Any existing plumbing, piping, valves, mechanical equipment, etc. serving the existing building which are shown or not shown on drawings and are required for systems operation shall remain in use. If these systems require relocation to allow installation of new systems,

the contractor shall be responsible for relocating to an Owner and Architect/Engineer approved location. The contractor shall pay all cost for this work and include such cost in his/her bid. (As specified previously, contractor shall be responsible for examining site and include all cost for work required to complete this project.)

- E. When active services, etc. are encountered in this project, the contractor shall furnish and install bracing, support, etc. as required to protect and keep these services active. (As specified previously, these drawings are diagrammatical. The contractor shall be responsible for verification of all existing services, piping, equipment, etc.).

#### 1.25 ACCESS TO EQUIPMENT, VALVES, ETC.

- A. Coordinate access panels with type of construction and furnish access panels in areas that are non-accessible. Access panels shall be furnished by this contractor and installed by the General Contractor. The access panels shall be all approved, UL labeled and fire rated and shall be located and sized to allow access to equipment, valves, etc.
- B. Where access panels are required, valves, equipment etc. shall be located as to require the least number of access panels.

#### 1.26 EQUIPMENT CONNECTIONS

- A. Connections to equipment, plumbing fixtures, etc. shall be made in accordance with shop drawings, rough-in dimensions furnished by the manufacturer, codes, etc. and may vary with connections shown on drawings. The contractor shall be responsible for making connections and number of connectors as per shop drawings, codes, etc. at no additional cost to the Owner.

#### 1.27 ELECTRICAL CONNECTIONS

- A. The Electrical Trades shall be responsible for furnishing and installing all electrical equipment, wiring, etc. required for operation of mechanical equipment unless otherwise noted on the drawings. The Mechanical Trades shall furnish detailed information and wiring diagrams to the Electrical Trades for all equipment specified and/or scheduled for this project. In the event that the Mechanical Trades furnishes an "approved equal" or "alternate" that require changes in the original electrical design, the Mechanical Trades shall pay all costs to the Electrical Trades as required to make satisfactory adjustments. All electrical work shall be done in accordance with the latest edition of the National Electric Code.

#### 1.28 MOTORS, MOTOR STARTERS AND DISCONNECTS

- A. Unless otherwise noted on drawings, motors shall be of constant speed 1750 rpm, new NEMA Design B, 40°C rise, horse power rated, open drip-proof except TEFC in dirty atmosphere, induction type motor with service factor of 1.15 and be of sufficient capacity to continuously operate the apparatus to which it is connected under all conditions of operation without exceeding nameplate ratings.
- B. Motors shall be premium efficiency as calculated using IEEE test method 112B.

- C. Motors  $\frac{1}{2}$  Hp. or larger shall be three phase; motors under  $\frac{1}{2}$  Hp. shall be 115 volt, 60 cycle, single phase. Before ordering the motors, the contractor shall verify correct motor voltage with the Electrical Trades and field conditions.
- D. The Mechanical Trades shall furnish, for equipment under Division 22, all special switches, disconnects, starters, alternators, etc. as specified or scheduled to be factory furnished and/or factory installed with the equipment including wiring diagrams, etc. whether it is to be factory installed or field wired. All other motor starters, disconnects, etc. not noted as factory furnished shall be furnished and installed by the Electrical Trades.
- E. Starters that are to be factory furnished with equipment shall be of the combination type and shall be as specified under Electrical Trades Division. Furnish overload protection for each phase.
- F. All wiring methods and materials shall meet NEMA, National Electric Code and State of Michigan Code requirements.
- G. All displays on control panels shall be on face of the panels.

#### 1.29 EXCAVATION AND BACKFILLING

- A. Furnish all excavation, backfilling and removal of excess dirt to accomplish installation of Division 22 mechanical work unless otherwise noted on drawings.
- B. All excavation shall be by open cut from the surface. Contractor shall determine whether excavation shall be by machine or by hand except where existing utilities may be located where excavation shall be by hand. Contractor shall be responsible for all damage to existing facilities and services. Excavation shall be to a depth of at least 6" to allow granular bedding below pipe or duct.
- C. If for any reason the work is suspended, the contractor shall properly protect the excavation and leave the areas unobstructed.
- D. Trench width shall allow sufficient width at centerline of pipe to allow at all times a first class construction/installation method but in no case should be less than 12" larger than the nominal pipe or duct size. This shall especially be true in areas that joints must be connected. Joint holes may have to be made with overhanging sides to make installation safe for workmen.
- E. The excavation shall be at all times finished and backfilled to the required grade after completion and approval of work. Not more than 100 feet of trench shall be excavated and open unless written approval is given by the Architect/Engineer.
- F. The subgrade shall be 4" to 6" below the pipe of granular bedding graded and tamped by hand or mechanical means to the exact elevation required at the bottom of the pipe. Granular materials shall be approved fine aggregate meeting MDOT #2NS specifications. This material shall pass a  $\frac{1}{2}$ " sieve but will be retained on a #4 sieve. If poor soil conditions exist which will not give proper support to the pipe, duct or structure, furnish granular fill as required to remedy this situation and give proper support.
- G. Furnish and install properly sloped sheet piled, shored and braced in areas that the soil requires this to maintain a proper excavation and prevent any movement of earth which could in any way damage the work under construction. When removing the sheeting and



bracing, special care should be taken to prevent any caving of the sides of the excavation and injury to the completed work or adjacent property.

- H. Take all necessary action to keep trenches and other excavation areas free from water at all times. Use such methods as pumping, ditching, well pointing, etc. to prevent water in trench or excavation. Dewatering of trench shall have constant supervision.
- I. Backfill excavation and trenches with approved granular material around sides of pipe and at least 12 inches above the top of the pipe laid not more than in 6 inch layers that are thoroughly tamped to 95% of its maximum density. There shall be no backfilling by any mechanical means until the granular material has been firmly tamped around the entire pipe to 12 inches above the pipe. All material used for backfilling shall be approved by the Architect/Engineer. Wherever trenching crosses walks or roadways or isolated inside of building, backfill top 6'-0" of trench with sand or bank run gravel in layers not to exceed 6 inches in depth and carefully compact by hand or machine. Do not backfill with frozen materials.
- J. No piping shall be covered until it has been tested, inspected and approved. Upon completion of backfilling, grade shall be restored in indicated elevation and left in reasonable condition for finish grade by others unless otherwise noted on drawings.
- K. Before final acceptance of work, all disturbed streets, drives, curbs, walks, parking areas, etc. shall be paved, graveled or other to as near their original condition as possible. All unused excavated material shall be removed from site if directed by the Architect/Engineer.

### 1.30 BASES AND SUPPORTS

- A. This contractor shall be responsible for furnishing all equipment pads and supports for equipment and materials required by Division 22 unless otherwise noted on drawings.
- B. All floor mounted mechanical equipment shall have a reinforced concrete pad furnished unless otherwise noted on drawings. The concrete pads shall be tied to the building floor with expansion bolts located maximum of 4'-0" on centers with a minimum of four (4) bolts, set before pouring and concealed within the pad. The Mechanical Trades shall verify exact pad or support size with the equipment manufacturer and shall size pad with adequate area to allow sufficient room for equipment mounting hardware, etc. Concrete pads shall have a 45 degree bevel at the top edge. The contractor shall verify exact location of concrete pads.
- C. Furnish all steel, hanging material, rods, etc. for suspending equipment off floor unless otherwise noted on drawings for equipment to be furnished under Division 22. This includes all structural steel for supporting between beams.
- D. All support structure shall be of strength to safely withstand all stresses and loads to which they will be subjected and shall distribute load properly over the building area. Supports shall be designed to avoid undue strain to equipment and to avoid interference with piping, pipe connections, service and maintenance clearances, etc.
- E. Where equipment is to be floor mounted and requires legs, this contractor shall furnish and install structural steel members or steel pipe and fittings for legs. Fasten and brace to equipment and furnish flange at base to allow bolting to floor.

- F. Where equipment is to be ceiling or wall mounted, furnish necessary platform, structural steel, hardware, etc. as is most suitable for support of this equipment.
  - G. All supports shall be approved by the Architect/Engineer.
  - H. All piping, plumbing, etc. shall be suspended from structural steel members utilizing rods and approved hanger devices. Do not use metal deck for support. Beam clamps such as the Grinnell Fig. 260 or approved equal shall be used. Sheet metal "straps" shall not be used in place of rods.
  - I. The mechanical trades shall be responsible for furnishing and setting in place all plumbing, piping roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required).
- 1.31 SLEEVES, PLATES AND COLLARS
- A. Furnish all sleeves, plates and collars for plumbing piping, etc. passing through walls, floor ceilings, foundations, etc. Coordinate with the General Contractor the exact location and size of required openings. No pipe shall pass through a wall, floor ceiling, etc. without a sleeve. This contractor shall be responsible for sleeve locations and securing sleeves before concrete is formed.
  - B. Sleeves for steel pipe shall be standard weight black steel pipe. For walls, foundations and ceilings, sleeve shall be kept flush with finished surfaces. For floors, the sleeve shall be set flush with bottom of concrete construction and be extended up ¼" above concrete floor. Sleeves shall be set in place before construction of walls, floors, ceilings, etc.
  - C. Sleeves for copper pipe shall be type "M" hard copper tubing installed typical to that of steel pipe sleeves.
  - D. Sleeves for piping shall be sized to allow insulation to run continuous through sleeve whenever possible and to allow not less than ¼" all around bare pipe or insulation.
  - E. Where insulated piping passes through walls or floor sleeves, furnish 22 gauge galvanized band around insulation of same length as the sleeve length. Band shall fit snugly over insulation and be held in place by steel metal collars all around insulation to cover openings.
  - F. All penetration voids shall be sealed smoke tight with non-combustible materials similar to 3M or Hilti firestop systems to maintain the integrity of the fire rated structure. In a non-rated assembly, seal all voids with non-hardening sealant.
  - G. Where bare piping 2" and smaller pass through wall or floors, furnish polished chrome plated brass escutcheons, split type. Bare piping 2½" and larger that pass through walls or floor, furnish 22 gauge galvanized steel metal collars so as to cover opening.

- H. Where piping penetrates an outside wall, below grade, utilize a mechanical sleeve, similar to Link-Seal, with stainless steel nuts and bolts on fasteners.

1.32 RIGGING AND HOISTING

- A. Perform all required rigging, hoisting, transportation, moving, etc. of all equipment, materials, etc. to be furnished and/or installed under Division 22 whether furnished by this contractor or by the Owner or other trades.

1.33 STORAGE FACILITY

- A. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

1.34 PROTECTION FROM DAMAGE

- A. The contractor shall be responsible for all materials, equipment, etc. and all work installed by himself and shall protect it from damage until final acceptance of this project by the Owner.
- B. Furnish all coverings and protection from dirt, dust, rain, storm, heat, traffic, wear, etc. and all possible injury including that by other workmen. Any equipment, workmanship, materials, etc. damaged prior to final acceptance by the Owner of this project shall be properly repaired at no expense to the Owner.
- C. Protect all plumbing fixtures and other equipment from damage by covering or coating. Any dented, scratched, rusted or marred surface finishes will not be accepted.
- D. Protect all equipment, materials, etc. from freezing.

1.35 COMMON PIPE MATERIALS AND INSTALLATION INSTRUCTIONS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Refer to individual Division 22 piping Sections for special joining materials not listed below.
  - 1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
    - a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
    - b. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
  - a. ABS Piping: ASTM D 2235.
  - b. CPVC Piping: ASTM F 493.
  - c. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - d. PVC to ABS Piping Transition: ASTM D 3138.
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

#### 1.36 PIPE HANGERS AND SUPPORTS

- A. Hangers and saddles shall be Modern Pipe Support Corp., Grinnel/Anvil, Autogrip, or M-CO. Inserts shall be of the type to receive a machine bolt head or nut after installation, permit horizontal adjustment, and shall be flush with the surface. For copper pipe with steel hangers, clean and wrap pipe with two layers of plastic insulating tape at point of contact. Roller supports shall be adjustable type with insulated standoff. Rods shall be used for suspended installation. Sheet metal "straps" shall not be used in place of rods.
- B. Hangers for piping with vapor barrier sealed insulation shall be multipurpose pipe saddles fitting over the insulation. Wire or perforated strap iron will not be permitted for pipe supports. Do not support hangers from roof deck. Furnish and install all support steel as required to suspend from structural steel joist or beams. Hangers shall be clevis or split ring type with vertical adjustment and beam clamp similar to Grinnell/Anvil Fig. 260, with maximum spacing per ASHRAE Standards:

| Pipe Size   | Steel Pipe | Copper Pipe | PVC Pipe | Rod Size |
|-------------|------------|-------------|----------|----------|
| ½ to ¾ inch | 6 feet     | 5 feet      | 4 feet   | 3/8"     |
| 1 inch      | 7 feet     | 5 feet      | 4 feet   | 3/8"     |
| 1 ¼ inch    | 7 feet     | 7 feet      | 4 feet   | 3/8"     |
| 1½ inch     | 7 feet     | 7 feet      | 4 feet   | 1/2"     |
| 2 inch      | 10 feet    | 8 feet      | 4 feet   | 1/2"     |
| 2½ inch     | 11 feet    | 9 feet      | 4 feet   | 5/8"     |
| 3 inch      | 11 feet    | 9 feet      | 4 feet   | 5/8"     |
| 3 ½ inch    | 13 feet    | 11 feet     | 4 feet   | 5/8"     |
| 4 inch      | 14 feet    | 12 feet     | 4 feet   | 5/8"     |
| 5 inch      | 14 feet    | 12 feet     | 4 feet   | 3/4"     |
| 6 inch      | 14 feet    | --          | 4 feet   | 3/4"     |
| 8 inch      | 16 feet    | --          | 4 feet   | 7/8"     |
| 10 inch     | 16 feet    | --          | 4 feet   | 7/8"     |

12 inch                      20 feet                      --                      4 feet                      1"

- C. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
  - D. Hangers for Pipe Sizes ½ to 1½ Inch: Malleable iron, adjustable swivel, split ring.
  - E. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - F. Hangers for Hot Pipe Sizes thru 4 Inches: Carbon steel, adjustable, clevis.
  - G. Hangers for Hot Pipe Sizes 5 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
  - H. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - I. Wall Support for Pipe Sizes up thru 3 Inches: Cast iron hook.
  - J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  - K. Vertical Support: Steel riser unistrut clamps at high, mid, and low locations.
  - L. Floor Support for Cold Pipe all sizes and Hot Pipe Sizes up thru 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - M. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  - N. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  - O. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustments, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.
- 1.37 PLUMBING, PIPING, AND EQUIPMENT SUPPORT
- A. Attachments of mechanical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points. When routing piping or ductwork perpendicular to joist, a support shall be provided at every steel joist; when parallel to joist, a support shall be provided at no more than 6' on centers or two panel bays. Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Mechanical Trades may contact the project Structural Engineer as required for panel point location assistance and welder certification requirements. Electrical Trades are still responsible for design, layout, and fabrication and installation of electrical supports and support attachment methods. Mechanical Trades shall submit attachment methods to the Structural Engineer for review.
  - B. Install products in accordance with manufacturer's instructions.
  - C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members without permission from Architect/Engineer.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

1.38 PIPING SYSTEMS SHUT OFF VALVES

- A. Shut off valves shall be installed at all branch lines off main piping, or where mains divide/separate to serve different areas, to allow isolation of all branch piping and systems they serve such as toilet rooms, areas or wings of the building, etc.

1.39 CLEANING AND FINISHING

- A. During construction period, remove all debris, rubbish, tools, equipment, unused materials, etc. as required or requested by the Architect/Engineer. All cost for cleanup and removal will be the responsibility of the contractor.
- B. Upon completion of the project and before final acceptance by the Owner, the entire installation shall be thoroughly cleaned, all rubbish and unused material removed to the satisfaction of the Architect/Engineer. All dust and dirt shall be removed from all equipment, piping, ductwork, etc.
- C. Thoroughly clean all floor drains, cleanouts, and plumbing fixtures. Clean all trays and strainers.

1.40 EQUIPMENT/SYSTEMS START-UP

- A. Furnish and schedule manufacturer's start-up service for all equipment and systems. These start-up services shall be performed in the presence of, and to the satisfaction of the Owner and Architect/Engineer.

1.41 EQUIPMENT/SYSTEMS SIGN-OFF

- A. The Mechanical Trades shall furnish written sign-offs on all systems stating that the equipment and systems have been checked, tested, started and that their operation has been verified correct through the entire range of operation that can be expected through the seasons.

1.42 SUBSTANTIAL COMPLETION

- A. Contractor shall submit a letter to the Architect/Engineer advising that all work has been completed in accordance with plans and specifications and the project is ready for a final walk-thru.

END OF SECTION

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SECTION 22 05 10

PLUMBING SYSTEMS TESTING, CLEANING, WATER TREATMENT & STARTUP

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing of piping systems.
- B. Cleaning of piping systems.
- C. Chemical treatment.
- D. Substantial completion check list and sign-off forms.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself, but is supplementary to the entire specification and drawings.

1.3 SCOPE OF WORK

- A. The work covered by this specification consists of furnishing all labor, equipment, material, chemicals or methods that are mentioned, listed or scheduled on drawings or are in this specification. This includes all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the cleaning, flushing, testing and chemical treatment of the piping systems for this project. The work covered under this section of the specification is in no way complete within itself, but is supplementary to the entire specification and drawings.
- B. The substantial completion forms shall be required to be signed and submitted to the Architect/Engineer for approval prior to any insulation of piping systems or installation of ceiling tiles. The person that signs the substantial completion forms shall witness the testing, flushing and chemical treatment of the systems. The signature person's company shall be responsible for all cost incurred with future work by the Architect/Engineer or Owner due to inadequate testing, cleaning, operation or chemical treatment of the piping systems.

1.4 SUBMITTALS

- A. Submit electronic copies of the completed and signed substantial completion forms included in this section. Submit to the Architect/Engineer as system flushing, testing, and chemical treatment occurs. The Mechanical Trade shall maintain one set of substantial completion forms and submit them to the Architect/Engineer prior to the Architect/Engineer final project walk-through.
- B. Submit electronic copies of all equipment, chemicals and product data being furnished to this project for approval.

- C. Submit electronic copies of manufacturer's installation instructions, including placement of equipment in systems, piping configuration, and connection requirements.
- D. Submit certificate of compliance from authority having jurisdiction, indicating approval of systems that require review by local and state authorities.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual installation locations of piping and equipment including sampling points and location of chemical injectors.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for public sewage systems.
- B. Products requiring electrical connection and listed and classified by UL as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems and system water for one year from date of substantial completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report to Owner after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Provide training course for Owner's personnel, instructing them on installation, care, maintenance, testing, and operation of the water treatment systems. Arrange course at startup of systems.
- E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based on these inspections.

1.8 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 WATER METER

- A. Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

PART 3 - EXECUTION



### 3.1 SANITARY AND STORM PIPING SYSTEMS

#### A. Testing

1. Conduct a water, air or peppermint test on the entire system in accordance with the State Plumbing Code. Test underground sanitary, storm and vent piping with at least a 10 foot head of water.

### 3.2 DOMESTIC COLD WATER, HOT WATER & HOT WATER RETURN PIPING SYSTEMS

#### A. Testing

1. Before any fixtures are connected, hydrostatically test piping system at 1.5 times the maximum system pressure, but not less than 100 psig in excess of working pressure for (4) hours. This pressure to be on piping only, not equipment.

#### B. Cleaning, flushing and disinfection.

1. All domestic water piping and equipment shall be completely flushed out and disinfected before placing system in service. Disinfection procedure and results shall be in accordance with all applicable codes and State Department of Public Health. (Piping shall be flushed until water is clear).
2. Ensure pH of water to be used as treatment is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or Acid (hydrochloric).
3. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L (50ppm) minimum residual.
4. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
5. Maintain disinfectant in system for 2 hours.
6. If final disinfectant residual tests less than 25 mg/L, repeat test.
7. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L or 0.5 ppm maximum.
8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and water entry, and analyze in accordance with AWWA-C51.
9. Verify that all tests and results are in accordance with local and state health codes and regulations.

### 3.3 NATURAL GAS PIPING SYSTEMS

#### A. Pressure Test

1. Pressure test shall be per the current adopted edition of the International Fuel Gas Code.
2. The test pressure shall not be less than 1.5 times the working pressure but not less than 3 PSIG. Where the test pressure exceeds 125 psig, the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe. The test duration shall be not less than ½ hour for each 500 FT<sup>3</sup> of pipe volume. If testing a system with less than 10 FT<sup>3</sup> of pipe volume the test shall not be less than 10 minutes.
3. The test medium shall be air, nitrogen, carbon dioxide or an inert gas. Oxygen shall not be used.

### 3.4 SYSTEM COMPLETION CHECKLIST

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

- A. The checklist which follows this specification section is to be considered part of the specifications.
- B. The checklist is to be completed by the Installing Contractor and the prime Mechanical Contractor for each item as directed.

END OF SECTION

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NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

| SYSTEMS COMPLETION CHECKLIST  |                 |                       |           |      |                                  |   |
|---|-----------------|-----------------------|-----------|------|----------------------------------|---|
| Inspection/Review Item  | Notice Required | Installing Contractor |           | Date | Owner's Representative Signature | Remarks   |
|   |                 | Name                  | Signature |      |                                  |   |
| <b>Plumbing Systems</b>   |                 |                       |           |      |                                  |   |
| Testing of Sanitary and Storm Systems   | 48 hours        |                       |           |      |                                  | Tested per specification  |
| Testing of Domestic CW, HW and HWR Piping.                                      | 48 hours        |                       |           |      |                                  | Tested per specification  |
| Disinfection of Domestic CW, HW & HWR Piping.                                   | 48 hours        |                       |           |      |                                  | Disinfect per specification and all applicable codes.   |
| Domestic Water Sample and Approval  | When submitted  |                       |           |      |                                  | Submit sample for review and approval by local authorities.   |
| Natural Gas Piping  | 7 days          |                       |           |      |                                  | Tested per specifications.  |
| Domestic water heater system, completely installed, checked, tested and started | 7 days          |                       |           |      |                                  | Verify system installation complete, operation correct. Includes verification of hot water recirculating pump system and flow balance. Check, test and startup by Manufacturer's Rep. |
| Valving   | When completed  |                       |           |      |                                  | Verify that valves have been installed at all branch piping locations   |
| Piping and Fitting Insulation   | When Completed  |                       |           |      |                                  | Verify all piping and fitting are insulated per specification.  |
| Reduced Pressure Backflow Preventer Tested                                      | 48 hours        |                       |           |      |                                  | Verify Reduced Pressure Backflow Preventer installed and completely operational.  |
| Sump Pumps and Sewage   | 48 hours        |                       |           |      |                                  | Verify system installation complete and operational.  |

By signing this form, the Contractor is certifying that he has personally witnessed completion of that item, and it is complete and complies with all respects to the drawings and specifications.

All items are to be signed off on and submitted to MacMillan Associates Inc. before a final project walk-thru by the Engineer is requested. If the Engineer discovers items incomplete and/or not in accordance with this checklist, the drawings, or the specifications, the Contractor will be backcharged for the Engineer's time and expenses.

SC-3

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

|          |  |  |  |  |  |  |
|----------|--|--|--|--|--|--|
| Ejectors |  |  |  |  |  |  |
|----------|--|--|--|--|--|--|

| SYSTEMS COMPLETION<br>CHECKLIST                   |                    |                       |           |      |                                     |  |
|---|--------------------|-----------------------|-----------|------|-------------------------------------|--|
| Inspection/Review Item                            | Notice<br>Required | Installing Contractor |           | Date | Owner's Representative<br>Signature | Remarks  |
|   |                    | Name                  | Signature |      |                                     |  |
| <b>Plumbing Systems, Continued</b>                |                    |                       |           |      |                                     |  |
| Pipe Labeling and Valve Tagging<br>Identification | When<br>completed  |                       |           |      |                                     | Verify system identification is complete per<br>specification and valve chart submitted. |
| Owner's Training                                  | 7 days             |                       |           |      |                                     | Verify that Owner has been instructed on<br>operation and maintenance of systems.        |

By signing this form, the Contractor is certifying that he has personally witnessed completion of that item, and it is complete and complies with all respects to the drawings and specifications.

All items are to be signed off on and submitted to MacMillan Associates Inc. before a final project walk-thru by the Engineer is requested. If the Engineer discovers items incomplete and/or not in accordance with this checklist, the drawings, or the specifications, the Contractor will be backcharged for the Engineer's time and expenses.

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SECTION 22 05 53

PLUMBING SYSTEM IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI or equal standards for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Submit list of working, symbols, letter size, and color coding for mechanical identification.
- B. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Furnish and install on all mechanical equipment.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1½ inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. ¾ to 1¼ inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ½ inch high letters.

2. 1½ to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ¾ inch high letters.
3. 2½ to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1¼ inch high letters.
4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2½ inch high letters.
5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3½ inch high letters.

- B. Stencil Paint shall be semi-gloss enamel, colors conforming to ASME A13.1.

## 2.4 PIPE MARKERS

- A. Color: Match existing or conform to ANSI/OSHA standards.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## 2.5 CEILING TACKS

- A. Description: Steel with ¾ inch diameter color coded head.
- B. Color code as follows:
1. Green - Plumbing valves

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as required by manufacturer's installations for stencil painting.

### 3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify each piece of equipment with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

- F. Identify valves in main and branch piping with tags.
- G. Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 22 06 00

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General information for piping systems, plumbing fixtures, backflow preventers, water heaters, etc. and general installation information.

1.2 FIELD MEASUREMENTS

- A. Field verify all equipment and fixture locations.
- B. Confirm that mill work is constructed with adequate provisions for the installation of countertop plumbing fixtures.
- C. Confirm all mounting heights and locations of plumbing fixtures to meet all barrier free and American Disabilities Act codes and regulations.

1.3 EQUIPMENT, FIXTURE & MISCELLANEOUS SPECIFICATIONS

- A. All equipment, plumbing fixtures, specialties, etc. that have been scheduled on drawings shall have the manufacturer's specification automatically included as part of this specification. All "approved substitute" or "voluntary alternate" equipment fixtures, etc. shall meet the capacities, quality, etc. of the scheduled items specification and capacities.

PART 2 PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. See Section 22 10 00 for Plumbing Piping.

2.2 MATERIALS AND FINISH

- A. Fixtures shall be of best quality vitreous china, acid resisting enameled cast iron or stainless steel, free from discoloration, chips, dents, warps, flaws, cracks, scratches, etc. or other blemishes. All vitreous china and enamel shall be white unless otherwise noted. Fixtures shall have manufacturer's guarantee label or trademark indicating first quality.
- B. All exposed pipe, fittings, traps, wastes, faucets, valves, handles, escutcheons, bolts, screws and accessories shall be polished chrome plated brass unless noted otherwise. Exposed traps shall be chrome plated brass, adjustable with cleanout plug and escutcheon.

2.3 PLUMBING FIXTURES - GENERAL

- A. Furnish all fixtures as shown and scheduled on drawings.
- B. Unless noted as "no substitutions", similar fixtures by the following manufacturers with equal or better qualities will be accepted as equal for:



1. Drainage Specialties - Josam, Sioux Chief, Smith, Wade, Watts, Zurn
  2. Plumbing Fixtures - American Standard, Bradley, Crane, Elkay, Fiat, Florestone, Just, Kohler, Mansfield, Moen Commercial, ProFlo, Sloan, Stern-Williams, Zurn.
  3. Plumbing Specialties - Schier, Watts, Wilkins, Zurn.
  4. Flush Valves - Delany, Delta, Sloan (Royal), Zurn, American Standard.
  5. Faucets - American Standard, Chicago, Delta, Sloan, T & S, Woodford, Zurn.
  6. Toilet Seats - Bemis, Centoco, Church, Olsonite, Kohler.
  7. Mixing Valves and Accessories - Powers, Symmons, Watts, Zurn, Reliance, Conbraco Appollo.
    - a. See 2.22 (this section) for emergency showers and eyewash stations.
  8. Electric Water Coolers and Drinking Fountains: Elkay, Halsey Taylor, Haws, Oasis.
- C. Provide all chair carriers, mounting hardware, etc. as required by the plumbing fixtures and wall construction. Where fixtures are located on walls, furnish and install suitable steel shapes well anchored in place and supported from floor as necessary to support fixtures. Each fixture shall be supported solidly and shall be sufficiently strong to withstand severe usage.
- D. Where plumbing fixtures occur in walls with pipe spaces in back of same, the supports for fixtures shall consist of chair carriers built into the wall with bolt projecting through face of wall for attachments of fixture brackets.
- 2.4 BACKFLOW PREVENTER
- A. Furnish and install type and quantity as shown on drawings or required by code. The Mechanical Trades shall furnish certification of all backflow preventers.
- B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013 and AWWA C506; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer and four test cocks.
- C. Double Check Valve Assemblies: ANSI/ASSE 1012 and AWWA C506; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
- 2.5 WATER HAMMER ARRESTORS
- A. Furnish and install on systems as required by local and state plumbing codes, latest edition.
- B. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

## 2.6 DOMESTIC WATER HEATER

- A. Refer to drawings and furnish all.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert and rim elevations.
- B. Coordinate all rough-in and/or final connections to equipment and plumbing fixtures. Plumbing fixtures shall be located as required to meet all barrier free and American Disabilities Act codes and regulations.
- C. Coordinate all piping invert elevations, location, routing, etc. to allow proper drainage from all plumbing fixtures to sewer mains. Verify all services existing and new for elevations, locations, etc. before commencing installation.

### 3.2 FIXTURE CONNECTIONS

- A. In general, unless otherwise noted on the drawings, the sizes of all the branch connections to fixtures shall be no smaller than those listed in the following schedule and as required by local and state plumbing codes, latest edition:

| Fixture                   | Waste | Vent | C.W. | H.W. |
|---------------------------|-------|------|------|------|
| Lavatory                  | 1¼"   | 1¼"  | ½"   | ½"   |
| Sinks (General)           | 1½"   | 1½"  | ½"   | ½"   |
| Janitor's Service Sink    | 3"    | 2"   | ½"   | ½"   |
| Water Closet-Flush Valve  | 4"    | 2"   | 1¼"  | ---  |
| Urinal-Flush Valve        | 2"    | 2"   | 1"   | ---  |
| Wall Hydrants (Hose Bibb) | ---   | ---  | ¾"   | ---  |
| Drinking Fountain         | 1½"   | 1½"  | ½"   | ---  |
| Showers                   | 2"    | 2"   | ¾"   | ¾"   |

### 3.3 INSTALLATION

- A. Plumbing fixtures and trim shall be protected against damage during construction. Fixtures damaged during this period shall be replaced.
- B. All valves, waste and water supply piping servicing fixtures exposed beyond face of finished walls shall be brass, nickel, and chromium plated. Where fixtures are mounted in countertops and cabinet work concealing valves and piping, chrome plated brass finishes are not required.
- C. All fixtures shall be independently valved with either integral stops or brass stops.
- D. Waste connections to floor or wall outlet fixtures shall be gas and water-tight; fastened with an approved setting compound, gasket or washer. Rubber gaskets or putty are not acceptable. The fixture shall be set the proper distance from the wall or floor.

- E. Where flush valves are specified with fixtures, supply to valve in each room shall be set at same height for that type of fixture, and valve shall be set in place so that center line of valve discharge is directly above center line of fixture spud. Bending of nipple between valve and spud to achieve connection will not be permitted.
- F. All brackets, cleats, plates, anchors, etc. required to support fixtures or piping rigidly in place shall be provided as work of this section and shall be installed behind finished walls.
- G. Provide and install basic fixtures from one major fixture manufacturer. Also, accessories such as faucets, strainers, stops, traps, etc. shall be manufactured by one major company where possible.
- H. All fixtures shall be set rigid, tight, plumb, level and true to assure rigidity and permanence. Provide chair carriers as manufactured by Wade, Josam, Zurn, or J.R. Smith for wall mounted fixtures. Carriers for wall mounted lavatories, drinking fountains, water coolers, and urinals shall have dual foot supports, tubular uprights, adjustable headers, alignment trusses, and all necessary accessories. Lavatory carriers shall be with concealed arms. Urinal carriers shall be with bearing plate. Water cooler and drinking fountain carriers shall be as required for proper support.
- I. All wall mounted fixtures shall be tested by bearing the weight of 500 pounds without sagging or pulling away from the wall. Damage resulting from this test shall be made good by this contractor. All other piping and fixtures shall be secured to walls with wall plates, wall hangers and approved expansion shields and bolts.
- J. Connections between earthenware fixtures and soil pipe flanges shall be made gas and water tight with closet setting compound or approved Neoprene gaskets, without use of putty. Hold down bolts shall be brass, not less than ¼" in diameter, and shall be equipped with nuts and washers.
- K. Provide each fixture with an approved compression service stop. Exposed stops shall be either loose key or screwdriver type.
- L. Caulk joint between wall and fixture at wall mounted lavatories, water closets, urinals, drinking fountains and service sinks with Silicone Sealant, white.
- M. Conductors:
  - 1. All inside conductors, except as otherwise specified, shall be caulked water tight and supported so as to provide for contraction, expansion and settlement of the building.
  - 2. All connections between outlet at roof drains and conductors shall be made and caulked watertight. Install all inside conductors and cooperate with the roofing contractor to properly install connections to the roof drains.
- N. Cleanouts:
  - 1. All soil, waste and drain pipes shall have cleanout at foot of stacks, outside near wall where line leaves building, at every change in the direction of run, at upper end of all horizontal runs, at intervals of not more than 100'-0" in straight runs of sanitary sewers and as required by code. All outlets shall be accessible so that drain line may

be readily cleaned with a snake or other rodding tool. Extend cleanouts to finished floor or finished wall.

O. Floor Drains

1. Floor drain pans shall be furnished and installed for all floor drains (except when floor drain is located in floors on fill) and be made of lead sheets weighting 4 lbs. per square foot or of an approved material, extending a minimum of 12" beyond lip of the flashing ring with outer edges turned up. All floor drains, floor sinks, etc. shall have deep traps installed.
2. All fixtures shall be trapped if required by local or state plumbing codes.
3. All trap seals that are subject to loss by evaporation shall have a trap seal primer valve installed as required by Local or State Plumbing Codes. A trap seal primer valve shall conform to ASSE 1018 or ASSE 1044.

P. Flashings: Vent pipe flashings shall be by roofing contractor. Provide lead sleeves for vents.

Q. Roof Drains: Furnish roof drains as scheduled on drawings, and all other accessories as required for installation and as recommended by the drain manufacturer. The General Contractor will be responsible for roof openings, roof opening supports and flashings.

R. Roof drain pans shall be furnished and installed for each roof drain and overflow roof drain. Pans shall be pre-cut 30"x30" and shall be recessed 1½" deep. Deliver pan to general contractor for installation by roof deck trades.

S. Pipe relief from backflow preventer to nearest drain.

T. Install water hammer arrestors as required by Code, complete with means for access if so required by the Plumbing Inspector.

U. Cold water supply branch to each toilet room shall be provided with shock absorbers designed and sized as recommended by the manufacturer to eliminate water hammer.

V. All exposed supplies and valves in finished areas shall be brass chrome plated. Supply lines to all hanging fixtures shall be from the wall, unless otherwise noted on drawings.

W. Install shutoff valves on all branches. All water supplies to fixtures shall have valve on supply line to the fixture.

X. All plumbing fixtures shall be installed, vented, piped, trapped, etc. in accordance with all codes and regulations pertaining to this projects location.

Y. Provide access to all thermostatic mixing valves and trap primer valves. If necessary, provide flush mounted stainless steel valve box with hinged cover and key lock.

Z. All fixtures supplied for bathing shall be supplied with a temperature control valve that conforms to ASSE 1016. All fixtures for hand washing shall be supplied with a temperature control valve that conforms to ASSE 1070.

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

END OF SECTION

MAI: 2022-1558

SECTION 22 07 00

PLUMBING PIPE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES PIPE INSULATION FOR:

- A. Domestic water piping system including cold water, hot water and hot water return.
- B. Horizontal rain water conductors.
- C. Horizontal and vertical overflow rain water conductors.
- D. Underside of roof drains.
- E. Outdoor piping.
- F. Valves and fittings.
- G. Miscellaneous.

1.2 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of the following specifications as applicable to the specific product or end use:
- B. American Society for Testing of Materials Specifications:
  - 1. ASTM C547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation"
  - 2. ASTM C533, "Standard Specification for Calcium Silicate Pipe & Block Insulation"
  - 3. ASTM C585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
  - 4. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only)
- C. Insulation materials, including all water and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.3 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following commercial piping systems, in accordance with the applicable project specifications and drawings, subject to the terms and conditions of the contract:
  - 1. Hot Piping - Piping system with fluids 105°F and higher.
  - 2. Cold Piping - Piping systems with fluids below 105°F. (Includes storm water systems)
- B. Insulation, vapor barriers, jacketing, hangers, supports, accessory materials, etc. shall be installed according to manufacturers recommendations.

#### 1.4 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.

#### 1.5 SYSTEM PERFORMANCE

- A. Insulation material furnished and installed hereunder shall meet the minimum thickness requirements of Standard 90.1 (12007), "Energy Efficient Design of new Buildings" of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) except minimum thickness shall be 1". However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.
- B. Insulation materials furnished and installed hereunder shall be Class A maximum of 25 flame spread, 35 fuel contributed and 50 smoke developed rating and shall meet the fire hazard requirements of each of the following specifications:
  - 1. American Society for Testing of Materials      ASTM E84
  - 2. Underwriters' Laboratories, Inc.                      UL 723
  - 3. National Fire Protection Associations              NFPA 255
- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

#### 1.6 QUALITY ASSURANCE

- A. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

### PART 2 PRODUCTS

#### 2.1 PIPE INSULATION ON INDOOR SYSTEMS

- A. Molded pipe insulation shall be manufactured to meet ASTM C585 for sizes required in the particular system.
- B. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C547. Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure\* two-component adhesive closure system, or Fiberglas Pipe and Tank Insulation, heavy density fiberglass insulation with end grain adhered to ASJ all service jacket. Joints shall be sealed by butt strips having a two-component sealing system or by applying staples and pressure sensitive tape. When self-sealing lap systems are used,

sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150°F. Manufacturer's data regarding thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layer(s) shall be unjacketed.

- C. Fittings and valves shall be insulated with preformed fiberglass fittings, fabricated sections of fiberglass pipe insulation, fiberglass pipe and tank insulation, fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall match that used on straight sections.
- D. Flanges, couplings, chilled water pump impeller housings, valve bonnets etc, shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with sections of insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable vapor resistant mastic.
- E. On cold systems, vapor barrier performance is extremely important. Particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. Valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. All penetrations of the ASJ and exposed ends of insulation shall be sealed with vapor barrier mastic.
- F. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
- G. All insulated, exposed piping inside the building within 8'-0" above the floor shall be additionally jacketed with a multi-ply, fabric reinforced, self adhesive insulation cladding material with a vapor barrier and a thickness of 0.015". Jacketing system shall be Venture Clad Plus #1579CW-E or equal.

## 2.2 REFRIGERANT PIPING AND COOLING COIL DRAIN WITH INSTALLATION TEMPERATURE ABOVE 40°F

- A. Insulate piping with ¾" Armstrong Armaflex type AP insulation. Insulation shall be flexible elastomeric thermal insulation, black in color, flame-spread rating of 25 or less and a smoke developed rating of 50 or less as tested by ASTM E84-91A "Method of Test Surface Burning Characteristics of Building Materials".
- B. Fitting elbow covers shall be fabricated from miter-cut tabular form. In all cases, butt joints and seams are to be sealed with Armstrong 520 adhesive. 520 adhesive is a contact adhesive; therefore, in all cases, both surfaces to be joined are to be coated with adhesive with installation temperature above 40°F.
- C. Where piping is located outdoors, cover Armaflex insulation with PVC jacketing installed with a glued application.

## 2.3 SUPPORT FOR PIPE WITH INSULATION

- A. All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that butt joints may be made outside the hanger.



1. On all size piping of cold systems, the pipe hanger saddles shall be separated away from the pipe by utilizing inserts. The vapor barrier shall be continuous, including material covered by the hanger saddle.
2. On warm water piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation.
3. For hot or cold piping systems larger than 3" in diameter, Owens-Corning Calcium Silicate pipe insulation shall be used for high density inserts. Piping saddles for piping larger than 3" shall not be in contact with the piping.
4. Owens-Corning Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi.
5. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
6. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of the insulation are being used.
7. On vertical runs, insulation support rings shall be used.

#### 2.4 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
  1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
  2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiberglass cloth, insulating cement; PVC fitting covers.
  3. Support materials - Hanger straps, hanger rods, saddles.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards".

#### 2.5 INSULATION THICKNESSES

- A. Fittings, including valves, flanges, unions, etc. shall be insulated with the same thickness as the required pipe insulation and covered with PVC fitting cover as specified.
- B. Pipe insulation thickness shall be as follows unless noted otherwise on drawings:

| <u>Piping System</u>                                      | <u>Pipe Size</u>            | <u>Insulation Thickness</u> | <u>Insulation Conductivity<br/>BTU-in<br/>H-FT<sup>2</sup>-F</u> |
|---|-----------------------------|-----------------------------|--|
| Domestic cold water                                       | All sizes                   | 1"                          | 0.28   |
| Horizontal rain conductor piping                          | All sizes                   | 1"                          | 0.28   |
| Horizontal and vertical overflow rain water conductors    | All sizes                   | 1"                          | 0.28   |
| Underside of roof drains                                  | All sizes                   | 1"                          | 0.28   |
| Domestic hot water and hot water return (140°F and under) | Up thru 1¼ " 1½" and larger | 1" 1½"                      | 0.28   |
| Domestic hot water and Hot water return (140°F to 200°F)  | Up to 1¼" 1½" and larger    | 1 ½" 2"                     | 0.28   |

### PART 3 EXECUTION

#### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project may comply with applicable specifications and standards and meet specified thermal and physical properties.

#### 3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. All damaged insulation installed will be removed and replaced by the Contractor at no extra cost to the Owner.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

#### 3.3 INSTALLATION

- A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
2. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit overall piping surfaces.
4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

B. Fittings

1. Cover valves, fittings, and similar items in each piping system using one of the following:
  - a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
  - b. Insulation cement equal in thickness to the adjoining insulation.
  - c. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

C. Penetrations

1. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.

D. Joints

1. Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band.
2. All pipe insulation ends shall be tapered and sealed, regardless of service.

3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.7 ASBESTOS INSULATION

- A. Any existing asbestos insulation on existing piping, valves, equipment, etc. where tie-ins are required, shall be removed by the Owner at Owner's expense. The contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

MAI: 2022-1558

SECTION 22 10 00

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary and storm piping system.
- B. Domestic water piping system
- C. Natural gas piping system.
- D. Valves.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI B31.1 - Power Piping.
- B. ANSI B31.2 - Fuel Gas Piping.
- C. ANSI B31.9 - Building Service Piping.
- D. ASME - Boiler and Pressure Vessel Code.
- E. ASME Sec. 9 - Welding and Brazing Qualifications.
- F. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- G. ASME B16.3 - Malleable Iron Threaded Fittings.
- H. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- I. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
- J. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- K. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
- L. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- M. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- N. ASTM A47 - Ferritic Malleable Iron Castings.
- O. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded.

- P. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- Q. ASTM A106 - Carbon Steel Seamless Pipe.
- R. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- S. ASTM A536 - Ductile Iron Castings.
- T. ASTM B32 - Solder Metal.
- U. ASTM B42 - Seamless Copper Pipe.
- V. ASTM B43 - Seamless Red Brass Pipe.
- W. ASTM B75 - Seamless Copper Tube.
- X. ASTM B88 - Seamless Copper Water Tube.
- Y. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube.
- Z. ASTM B302 - Threadless Copper Pipe (TP).
- AA. ASTM B306 - Copper Drainage Tube (DWV).
- AB. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- AC. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- AD. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.
- AE. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- AF. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- AG. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- AH. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- AI. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping.
- AJ. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.
- AK. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- AL. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- AM. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.

- AN. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- AO. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- AP. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- AQ. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System.
- AR. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- AS. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- AT. ASTM F891, Schedule 40 Cellular Core PVC-DWV Pipe.
- AU. AWS A5.8 - Brazing Filler Metal.
- AV. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- AW. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- AX. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- AY. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- AZ. AWWA C606 - Grooved and Shouldered Joints.
- BA. AWWA C651 - Disinfecting Water Mains.
- BB. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- BC. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- BD. NCPWB - Procedure Specifications for Pipe Welding.
- BE. NFPA 54 - National Fuel Gas Code.
- 1.3 QUALITY ASSURANCE
  - A. Valves: Manufacturer's name and pressure rating marked on valve body.
  - B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
  - C. Welders Certification: In accordance with ASME Sec 9.

- D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- E. All castings used for coupling housings, fittings, valve bodies, etc. shall be date stamped for quality assurance and traceability.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.1 SANITARY AND STORM SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING (Must be approved by governing authorities)

- A. Piping up thru 8": Cast iron ASTM A74 service weight with cast iron fittings ASTM C564 neoprene gasket system joints.
- B. Piping 10" and above: Reinforced concrete pipe with ASTM C-76 Class III specification when piping is located below a paved surface. All other pipe shall be reinforced concrete pipe with ASTM C-76 Class II specification. Joints shall be bell and spigot pattern with "Tylex" gasket material on sanitary piping or cemented joints with "Dewitt" No. 10 caulking around compound on storm piping. Joints shall conform to ASTM V-443.
- C. Schedule 40 PVC Pipe: ASTM D2729 and ASTM F891 DWV non-pressure cellular core.
  - 1. Fittings: PVC
  - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- D. Dual wall corrugated polyethylene pipe may be used for storm when approved in writing by the Engineer, pipe sizes thru 10" shall meet AASHTO M252S, pipe sizes 12" thru 36" shall meet AASHTO M294S. Corrugated pipe shall have smooth inner liner. Acceptable manufacturers shall be Hancor or ADS.

#### 2.2 SANITARY, STORM AND VENT SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING (Must be approved by governing authorities)

- A. Gravity Cast Iron Pipe: ASTM A74 service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.



- B. Gravity Cast Iron Pipe: CISPI 301, hubless, service weight
  - 1. Fittings: Cast iron.
  - 2. Joints: ASTM C564, neoprene gasket system.
- C. Gravity Schedule 40 PVC Pipe: ASTM D2729 and ASTM F891 DWV non-pressure cellular core.
  - 1. Fittings: PVC.
  - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- 2.3 SANITARY, STORM AND VENT PIPING, ABOVE GRADE (Must be approved by governing authorities)
  - A. Gravity Cast Iron Pipe: ASTM A74, service weight.
    - 1. Fittings: Cast iron.
    - 2. Joints: ASTM C564, hub and spigot, neoprene gasket system.
  - B. Gravity Cast Iron Pipe: CISPI 301, hubless, service weight.
    - 1. Fittings: Cast iron.
    - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
  - C. Gravity Steel Pipe: ASTM A53 Schedule 40, galvanized.
    - 1. Cast Iron Fittings: ASME B16.1, flanges and fittings; ASME B16.4, screwed fittings.
    - 2. Malleable Iron Fittings: ASME B16.3, screwed type. ASTM A47.
    - 3. Ductile Iron Fittings: Grooved end, ASTM A536.
    - 4. Mechanical Grooved Couplings: Ductile iron, galvanized. (as specified for Forced Drains)
  - D. PVC Pipe: ASTM D2729 (when approved by the Architect/Engineer).
    - 1. Fittings: PVC.
    - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
  - E. CPVC Pipe: ASTM D2846 (When approved by the Architect/Engineer).
    - 1. Fittings: ASTM D2846, CPVC
    - 2. Joints: ASTM D2846, solvent weld with ASTM F493 solvent cement.
- 2.4 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING (Must be approved by governing authorities)
  - A. Ductile Iron Pipe: ANSI/AWWA C151/A21.51 rated 350 psi with Class 350 fittings.
    - 1. ANSI thickness Class 50 minimum, nominal pipe wall thickness .27" minimum, rated 350 psi at laying condition Type 1.
    - 2. Cement lined as per AWWA C104 (ANSI A21.4)
    - 3. Pipe Joints: Push on, ANSI/AWWA C1533/A21.53, with Tyton gaskets.
    - 4. Fitting Joints: Mechanical, compact, ANSI/AWWA C153/A21.53, with stainless steel or Corten anti-rotation bolts and sacrificial zinc anode cap on each bolt.
    - 5. Coating: Exterior of pipe and fittings, asphaltic coating as per ANSI/AWWA.
    - 6. Polyethylene encasement as per ANSI/AWWA C105/A21.5.
    - 7. Concrete thrust blocks, installation, etc. as per published engineering and construction standards of Michigan Department of Transportation and local codes.
    - 8. All material and installation shall be in accordance with manufacturer's recommendations.

- B. Copper Tubing: 2" and smaller - ASTM B88, Type K soft temper.
    - 1. Fittings: ASME B16.18 cast bronze or ASME B16.22 wrought copper and bronze.
    - 2. Joints: AWS A5.8, BCuP silver braze if allowed by code, otherwise ASTM B32 solder, lead free Grade 95-5 tin-antimony or tin-silver, with melting range of 430 to 535 degrees F.
  - C. Polyethylene Pipe 1½" or smaller
    - 1. Pipe - Polyethylene (PE) flexible plastic, ASTM D2239 rated 160 psi minimum.
    - 2. Fittings - PE barbed insert fittings.
    - 3. Joints - Stainless steel clamps over barbed insert fittings.
  - D. PVC Pipe:
    - 1. 2½" and 3" - ASTM D2241, SDR 21 - Class 200 AWWA C900.
    - 2. 4" and Larger - ASTM D2241, DR18-Class 150 AWWA C900.
    - 3. Fittings: ASTM D2466, PVC
    - 4. Joints: ASTM D3139, integral bell and gasket seal installed with concrete thrust block or ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- 2.5 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING (Must be approved by governing authorities)
- A. Ductile Iron Pipe: ANSI/AWWA C151/A21.51 rated 350 psi. with Class 350 fittings.
    - 1. ANSI thickness Class 50 minimum, nominal pipe wall thickness .27" minimum, rated 350 psi at laying condition Type 1.
    - 2. Cement lined as per AWWA C104 (ANSI A21.4)
    - 3. Pipe Joints: Push on, ANSI/AWWA C1533/A21.53, with Tyton gaskets.
    - 4. Fitting Joints: Mechanical, compact, ANSI/AWWA C153/A21.53, with stainless steel or Corten anti-rotation bolts and sacrificial zinc anode cap on each bolt.
    - 5. Coating: Exterior of pipe and fittings, asphaltic coating as per ANSI/AWWA.
    - 6. Polyethylene encasement as per ANSI/AWWA C105/A21.5.
    - 7. Concrete thrust blocks, installation, etc. as per published engineering and construction standards of Michigan Department of Transportation and local codes.
    - 8. All material and installation shall be in accordance with manufacturers recommendations.
  - B. Copper Tubing: 2" and smaller - ASTM B88, Type K, soft temper.
    - 1. Fittings: ASME B16.18 cast bronze or ASME B16.22 wrought copper and bronze.
    - 2. Joints: AWS A5.8, BCuP silver braze.
    - 3. No joints shall be located under floor unless standard pipe lengths are not long enough for the entire length of bury, then joints shall be kept to a minimum.
  - C. PVC Pipe
    - 1. 3" - ASTM D2241, SDR 21- Class 200 AWWA C900.
    - 2. 4" thru 12" - ASTM D2241, DR18 - Class 150, DR18 - AWWA C900.
    - 3. Fittings ASTM D2466, PVC.
    - 4. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- 2.6 DOMESTIC WATER PIPING, ABOVE GRADE INSIDE BUILDING (Must be approved by governing authorities)

- A. Domestic water piping 6" and smaller shall be: Copper tubing: ASTM B88, Type L, hard drawn, seamless.
1. Fittings: ASME B16.18 cast bronze tee tap or ASME B16.22 wrought copper and bronze.
  2. Fittings 1-1/2" and smaller: ASME B16.18 cast bronze or ASME B16.22 wrought copper, with 301 stainless steel internal components, EPDM seals, and push-to-connect ends. Victaulic Permalynx.
  3. Joints: ASTM B32, solder, Lead free Grade 95-A tin - antimony or tin and silver with melting range 430 to 535 degrees F or AWS A5BcuP silver braze.
  4. Fittings 2" and smaller: At the Contractor's option, Schedule 10S stainless steel pipe with Vic-Press 304 fittings and couplings may be used in lieu of soldered copper. The seal material shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.
  5. Joints 2" thru 8" may be mechanical pipe couplings of a bolted type with a central cavity design pressure-responsive gasket along with grooved end copper or bronze fittings as available, as manufactured by Victaulic.
    - a. Copper Tube, ASTM B-88 (Type K or L) - Roll grooved only, at copper-tube dimensions. (Flaring to accommodate alternate sized couplings is not permitted).
    - b. Mechanical Couplings - Shall be Victaulic Style 607H "Installation-Ready" rigid couplings for copper consisting of a ductile iron cast housing, with offsetting angle-pattern bolt pads, a synthetic rubber gasket of a central cavity pressure-responsive design, with ASTM A449 plated nuts and bolts to secure unit together.
    - c. Coupling Housings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12), with a copper colored enamel paint coating.
    - d. Gaskets - Shall be molded of synthetic rubber in a Flush-Seal configuration conforming to the copper tube size (CTS) outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000. Reference shall always be made to the latest published Selection Guide for Gaskets for proper gasket selection for the intended service.
    - e. Water Service - Gasket supplied for water services from -30°F to +230°F Grade "E" EPDM compound molded of materials conforming to ASTM D-2000, designation 2CA615A25B24F17Z, recommended for hot water service within the specified temperature range, plus a variety of dilute acids, oil-free air, and many chemical services. Not recommended for petroleum services.
      - 1) Gaskets supplied with Style 607H couplings shall be grade EHP for water services from -30°F to +250°F.
      - 2) Gaskets shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.
      - 3) Meets the low lead requirements of NSF-372.
    - f. Flange Adapters - Shall be Victaulic Style 641 Vic-Flange or equal adapters 2"-6", ductile iron ASTM A-536, engaging directly into roll grooved copper tube and fittings and bolting directly to ANSI Class 125 cast iron and Class 150 steel flanged components; installer to supply standard flange bolts. Flange casting shall have a corresponding gasket.

- g. Fittings - Fittings shall be full flow (smooth turn elbows) copper fittings conforming with ASME B16.22 or cast bronze to ASME B16.18; with grooves designed to accept grooved end couplings at copper-tube dimensions. (Flaring to accommodate alternate sized couplings is not permitted). Victaulic Copper-Connection.

2.7 NATURAL GAS PIPING BURIED (Must be approved by governing authorities and local gas utility company)

- A. Approval must be given in writing by the local gas company for type of material to be used and the proposed installation method

- B. Polyethylene Pipe: ASTM D2513, SDR 11.5.

- 1. Joints and Fittings: Plastic pipe and fittings shall be joined in accordance with manufacturer's instructions. Piping shall be allowed to be joined by methods of heat fusion, or mechanical fittings designed for pipe made to ASTM D 2513 Standards.
  - a. Heat fusion joints shall be made in accordance with manufacturer's recommendations and shall be made by certified personnel in accordance with qualified procedures proven to make gas tight joints as strong as the pipe or tubing being joined.
  - b. Mechanical joints shall be compatible with the plastic piping and gas in the system. A stiffener should be inserted when using OD compression type fittings. The stiffener should be sized specifically for the pipe being installed and should equal the insertion depth of the pipe. Split tubular stiffeners shall not be used.
- 2. Continuous insulated No. 14 copper tracer wire shall be installed with and attached to underground non-metallic gas piping and shall terminate above grade at each end.
- 3. Install polyethylene pipe a minimum of 24" below grade, backfill with clean yellow sand to 6" below grade, and install yellow plastic warning tape 6" below grade above the pipe.
- 4. Polyethylene pipe entering or emerging from the ground at locations exterior from the building shall be additionally protected by encasing with ASTM A53, Schedule 40 black steel pipe to a height of, if practical, 18" below to 6" above the ground.
- 5. Piping penetrating below grade through a foundation or basement wall shall be encased with steel, wrought iron, PVC or ABS Schedule 40 piping. The circular space behind the piping and the sleeve shall be sealed.

2.8 NATURAL GAS PIPING, ABOVE GRADE INSIDE OF BUILDING OR OUTDOORS EXPOSED

- A. Steel Pipe: ASTM A53, Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron or ASTM A234, forged steel welding type.
  - 2. Joints: NFPA 54, threaded or welded to ANSI B31.1, ANSI B31.2, ANSI B31.9, ASME Sec. 9.
  - 3. If both ends of the pipe sleeve within the same building terminate indoors, the pipe sleeve shall not be sealed or vented.
  - 4. If one end of the pipe sleeve terminates outdoors and the other terminates indoors, the pipe sleeve shall be sealed and vented.
  - 5. Exterior piping shall be painted with paint for steel pipe and outdoor rated.

2.9 NATURAL GAS PIPING INSIDE BUILDING, BELOW GROUND, INSIDE SOLID WALLS OR SOLID FLOORS

- A. Steel pipe, ASTM A53, Schedule 80, black iron with welded joints, encased in a Schedule 40 steel, wrought iron, PVC or ABS pipe sleeve. The sleeve shall be sealed and capable of containing full gas pressure in the event of a leak in the gas pipe. The sleeve shall be vented to a vent located 12" min. above the roof with a cap to prevent the entrance of water and insects. All gas piping shall be in conformance with the National Fuel Gas Code NFPA 54, the requirements of the State Building Code, the local Fire Marshal and the Office of Fire Safety (OFS).
  - 1. The gas shutoff valves serving the Science Rooms shall be made accessible from the Corridor. Each shutoff valve shall be located in a recessed box furnished and installed by the General Contractor. Each shutoff valve shall serve to shut off all gas outlets in the one adjacent room only.
  - 2. All gas piping located below the floor shall be located under the concrete, not in the concrete, and shall be located a minimum of 12" below the top of the floor.

2.10 NATURAL GAS PIPING IN CONCEALED LOCATIONS

- A. Steel pipe, ASTM A53, Schedule 80, black iron with welded joints.
  - 1. A concealed location is a location that cannot be accessed without damaging permanent parts of the building structure or finish surface. Spaces above, below or behind removable panels or doors shall not be considered concealed.

2.11 GENERATOR EXHAUST PIPING

- A. Steel Pipe ASTM A 312 seamless welded austenitic intended for high temperature and generally corrosive service.
- B. Fittings: Long radius, welded.

2.12 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 22 05 00.

2.13 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under:
  - 1. Ferrous pipe: 150 psig malleable iron threaded unions.
  - 2. Copper tube and pipe: 150 psig bronze unions with soldered joints. (Solder shall be lead free.)
- B. Pipe Size Over 2 Inches:
  - 1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
  - 2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:

1. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)
  2. Housing: Two ductile iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion where required; electroplated steel bolts, nuts, and washers conforming with ASTM A449; galvanized for galvanized pipe.
  3. Sealing gasket: "C" shape or FlushSeal composition sealing gasket.
  4. Gaskets shall be UL classified in accordance with ANSI/NSF-61 for Potable water service.
  5. Basis of Design: Victaulic Company, Style 607H (Installation-Ready for Copper Tubing) and Style 107H or 177 (Installation-Ready for Steel Piping).
- D. Dielectric Connections: Dielectric nipples shall be non-conducting for connection of dissimilar materials. Dielectric nipples shall be similar to Victaulic Style 647 or Style 47. A brass adapter dielectric union is not acceptable.
- 2.14 GATE VALVES
- A. Up to and including 3 Inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.
  - B. Over 3 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge, flanged or grooved ends. Basis of Design: Victaulic Series 771V.
- 2.15 GLOBE VALVES
- A. Up to and including 3 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity (repackable under pressure).
  - B. Over 3 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
- 2.16 BALL VALVES
- A. Up to and including 3 Inches:
    1. Bronze one piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops, solder or threaded ends with union.
    2. Brass two piece body, chrome plated brass ball and stem, PTFE seats and seals, lever handle, and Vic-Press ends. Victaulic Series P589.
  - B. Over 1-1/2 Inches: Cast ductile iron steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, flanged or grooved ends. Basis of Design: Victaulic Series 726.
- 2.17 PLUG VALVES
- A. Up to and including 3 Inches:

1. Elastomer coated ductile iron disc with integrally cast stem, copper-tube dimensioned grooved ends, lever handle or gear operator. Basis of Design: Victaulic Series 608.

2. Bronze body, bronze tapered lubricated plug, teflon packing, threaded ends.

B. Over 3 Inches:

1. Cast iron body and lubricated plug, flanged ends.

2. Elastomer coated ductile iron plug with integrally cast stem, ductile iron body and bonnet, welded-in nickel seat, lever handle or gear operator. Basis of Design: Victaulic Series 377.

- a. For installation on IPS / Steel pipe sizes with Victaulic Style 307 transition coupling.

2.18 BUTTERFLY VALVES

A. Bronze body

1. Elastomer coated ductile iron disc with integrally cast stem, copper-tube dimensioned grooved ends, lever handle or gear operator. Basis of design: Victaulic Series 608.

2. Stainless steel disc, resilient replaceable seat, threaded ends, extended neck, 10 position lever handle.

B. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable pressure responsive EPDM seat, wafer or lug ends or grooved ends if Victaulic grooved fittings are used, with extended neck and 10 position lever handle. (Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating). Sizes 6" and larger furnish gear drive handwheel. Basis of Design: Victaulic MasterSeal™.

2.19 FLOW CONTROL VALVES

A. Construction: DZR brass (Ametal) or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.

1. Body material shall be ISO 6509 compliant.

B. Calibration: Control flow within 3.5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

C. Manual (Multiple Turn Balancing Valves): Victaulic Series 786/787/78K circuit balancing valve.

D. If called for on drawings, furnish Victaulic or Griswold flow control valve. Flow control valve shall automatically control flow rates with  $\pm 5\%$  accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/helical spring to avoid corrosion. Four operating ranges shall be available with minimum range requiring less than 2 psig to actuate the mechanism. Manufacturer shall provide independent laboratory tests

verifying accuracy and performance. Griswold flow control valve shall have a 5 year warrantee to guarantee all materials and workmanship. See drawings for flow rate of valve.

## 2.20 SWING CHECK VALVES

- A. Up to and including 3 Inches: Bronze swing disc, solder or screwed ends.
- B. Over 3 Inches: Iron body, stainless steel or bronze trim, swing disc, renewable disc and seat, grooved or flanged ends. Basis of Design: Victaulic Series 712.

## 2.21 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer, or flanged ends.
- B. Ductile iron body, stainless steel spring and shaft aluminum-bronze disc with elastomer seal or elastomer coated ductile iron disc with welded-in nickel seat, grooved ends. Basis of Design: Victaulic Series 716.

## 2.22 WATER PRESSURE REDUCING VALVES

- A. Up thru 3 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, double union ends.
- B. Over 3 Inches: Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.
- C. Valve shall be as manufactured by Bell and Gossett.

## 2.23 RELIEF VALVES

- A. Furnish and install as shown on plans a diaphragm-assist operated bronze body ASME rated and nameplated safety relief valve with fail-safe disc to assure normal operation under emergency conditions. The valve shall have a low blowdown differential and shall be designed to relief system pressure in excess of the operating pressure specified for the system, within the maximum operating limitations of the valve. The ASME safety relief valve shall be engineered to prevent the system fluid from entering the spring chamber under normal operating conditions. The permanent valve nameplate shall display the BTUH and relief pressure ratings certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be as manufactured by Bell and Gossett.

## 2.24 STRAINERS

- A. Size 3 inch and Under: Screwed brass body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- C. Grooved-End Strainers: Size 2 inch through 12 inch, 300 psig working pressure, Y-pattern with 1/16 or 1/8 inch stainless steel perforated screen. Victaulic Series 732.

## 2.25 INSERTS



- A. Inserts: Malleable iron case of steel shell and expansion plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.26 CONCRETE FOR THRUST RESTRAINT AND COLLARS

- A. Concrete: Class A Concrete conforming to Divisions 500 and 700 of the SCDOT Standard Specifications.
  - 1. Compressive strength of 3,000 psi at 28 days.
  - 2. Air entrained.
  - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
  - 4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
  - 5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)

### 3.3 PLUMBING PIPING INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Dielectric nipples for connection of dissimilar materials. A brass adaptor dielectric union is not acceptable.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 1. For water systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the

elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the engineer). Where expansion loops are required, use Victaulic Style 77 couplings on the loops.

- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- I. Establish elevations of buried piping outside the building to ensure not less than 4'-0" of cover for sewers and not less than 5'-6" of cover for domestic water piping.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to weld.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- M. Underground sewers shall be a minimum of 3" in diameter. Sewers located within building shall have a minimum slope of 1/4" per foot for piping 3" and smaller and a minimum slope of 1/8" per foot for piping 4" and larger.
- N. All junctions of drainage piping shall be made with combination "Y" and 1/8 bend fittings.
- O. Install bell and spigot pipe with bell end upstream.
- P. Terminate plumbing vents 12" minimum above roof. Furnish and install weather cap on top of all vent pipes.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Solder or "sweat" joints shall be used for all copper and brass fittings, valves and tubing, using the soldering flux and methods recommended by the manufacturer of the tubing and fittings. Solder shall be silver solder for buried piping. No lead solder shall be used on any potable water piping.
- S. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- T. Equipment using gas and related piping shall be installed in compliance with NFPA 54 and 58, as applicable.
- U. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufacturer's instructions.
- V. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- W. Maintain minimum 10-foot horizontal separation and 18 inch vertical separation of water main from sewer piping or as required by local code.

### 3.4 PLUMBING PIPING APPLICATION

- A. Use grooved mechanical couplings and fasteners in accessible locations, risers and pipe chases with Architect/Engineer's approval.
  - 1. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
- B. Install unions downstream of valves and at equipment or apparatus connections. Unions are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers. All branch piping take-offs from mains, risers, or branch piping shall have valves installed to allow isolation of branch piping.
- E. Install globe, ball, or butterfly valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide plug valves in gas systems for shut-off service. Provide removable or fixed handle for each plug valve.
- H. Provide flow controls in water recirculating systems where indicated.

### 3.5 INSTALLATION OF INSERTS

- A. Install in accordance with manufacturer's instructions.
- B. Provide inserts for placement in concrete formwork.
- C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- F. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

### 3.6 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1½ inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat and finish paint exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed. Hangers and supports located in mechanical spaces are considered exposed.

### 3.7 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to minimum 1/8 inch per foot for piping 4" and larger, ¼" per foot for piping 3" and smaller. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

### 3.8 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing. Contractor shall pay all fees, cost, etc. to local authorities for tap-ins, inspections, etc. as required.
- B. Provide new water service complete with reduced pressure backflow preventer, double check valve assembly or water meter with by-pass valves as required by the local authorities.
- C. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

- D. Contractor shall pay all fees, costs, etc. to local authorities for tap-ins, inspections, etc. as required.
- E. Provide new gas service complete with gas meter and regulators. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment. Gas company is responsible for installation of gas service and meter. Contractor shall be responsible for all coordination, etc. Contractor shall inform the gas company of gas load for service for the building and meter size by the gas company. Owner shall pay all gas company charges for gas service directly to the gas company.

### 3.9 NATURAL GAS PIPING

- A. Natural gas piping located outdoors shall be prime painted and finish painted with rust prohibitor paint that includes zinc. Color shall be selected by the Architect.
- B. Natural gas piping supports shall occur on 8'-0" centers and at changes in direction.
- C. Natural gas piping installed outdoors on the roof shall be supported at a minimum of 3½" above roof level.
- D. Roof supports shall be a manufactured support similar to PHP-SS8 or equal by Miro.

### 3.10 POLYETHYLENE ENCASEMENT

- A. Encase Ductile Iron piping in polyethylene where indicated on drawings to prevent contact with surrounding backfill material.
- B. Install in accordance with AWWA C105, Method A.
- C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

### 3.11 CONCRETE THRUST RESTRAINT

- A. Provide valves, tees, bends, caps, plugs and dead ends with concrete thrust blocks as indicated on drawings.
- B. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair.
- C. Do not encase fitting joints and flanges.

END OF SECTION

MAI: 2022-1558

SECTION 23 05 00  
HVAC REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SPECIFICATIONS AND DOCUMENTS

- A. Drawings and related specifications for this project including General and Supplementary Conditions, Division 1, General Requirements, Instructions to Bidders, Addenda's, etc. apply to and are considered a part of Division 23 - Mechanical Work.
- B. Information in this division is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions, and Division I of these specifications. Any conflict between this Division 23 and other sections or divisions of the specifications or drawings shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.
- C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor, materials, equipment and incidentals necessary for their complete installation and operation.
- D. All information contained in this section applies to all sections within Division 23 as if it was part of each section.

1.2 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are intended to supplement each other and any material or labor called for in one shall be furnished even if not specifically mentioned in both. Any material or labor which is neither shown on the drawings nor listed in this specification, but is normally incurred or required for completion of work shall be furnished. If there is a discrepancy between the drawings and specifications, the more stringent of the two shall be followed.
- B. Drawings are diagrammatic and are intended to show approximate location and general arrangement of systems and equipment. No attempt has been made to show every ell, tee, etc. Drawings shall not be scaled for location of systems, equipment, etc. All dimensions whether given on drawings or scaled shall be verified in field and coordinated with all other trades and existing field conditions. Some ductwork, piping, equipment, etc. locations may require changes in location due to field conditions and coordination with other trades will be made with no additional cost to the Owner. Failure to check will be no reason for additional compensation.
- C. These drawings and the associated specifications are intended to provide complete furnishing, installation and operational HVAC systems as specified. If these drawings and associated specifications have information omitted that would not allow a completely operational system as is the intent of the Engineer, the bidder shall notify the Engineer a minimum one week prior to the bid date to allow for addenda. Once bids have been received, the Contractor shall be responsible for material, labor, etc., to furnish and install a completely operational mechanical system as is the intent of these drawings and associated specification.

- D. The installation of all systems, equipment, etc., is subject to clarification with submitted shop drawings and field coordination requirements. Equipment outlines shown on drawings or dimensioned on drawings are limiting dimensions. Any equipment that reduces the indicated clearances or exceeds specified or scheduled equipment dimensions shall not be used.
- E. The Architect/Engineer and Owner reserve the right to make minor changes in the location of equipment, piping, ductwork, etc. at the time of rough-in without additional cost to the Owner.
- F. The Mechanical Trades Contractor shall have completed for his portion of work, at least one installation of size and type comparable to this project and has been in satisfactory operation for at least two complete years. The Mechanical Trades Contractor shall also have a developed service department capable of negotiating service contracts with the Owner for systems herein specified.

### 1.3 AUTOCAD BACKGROUND FILES

- A. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

### 1.4 MANUFACTURER'S SPECIFICATIONS AND CAPACITIES

- A. Some equipment, materials, etc. that are scheduled on the drawings or listed in any addenda may not be specified in this specification. The manufacturer's specification and capacities shall be considered included and part of this specification whether it is specified in this specification or noted or scheduled on the drawings. The contractor shall remove and replace any "substituted" equipment or material that has been installed or is on site, which in the opinion of the Architect/Engineer does not meet the scheduled equipment or materials manufacturer's capacities or specification at no additional cost to the Owner.

### 1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.6 LOCAL CONDITIONS

- A. Before submitting proposals, each contractor shall examine these specifications and associated drawings, addenda, etc. and shall examine the site of the project. The bidder shall fully investigate the site of this project, investigate coordination of his work with all other trades and existing conditions and completely satisfy himself as to the conditions to which the work is to be performed before submitting his/her bid. No allowances or considerations will be given at a later date for alleged misunderstanding as to the requirements of the work, materials to be furnished, or conditions required by the nature of this project site and coordination by the neglect on the bidder's part to make such an examination and coordination.
- B. Drawings show approximate location of existing services. The mechanical and electrical trades shall check with local utility companies or municipal agencies for exact location of services which they expect to encounter. The Mechanical Trades Contractor shall be responsible for hiring a company such as "Miss Dig" to stake out and locate all utilities in areas of excavation before commencing any work. The Mechanical Trades Contractor shall verify all elevations and locations of existing underground lines which are to be connected into or routed over or under. This verification shall be done prior to beginning work at this project.

1.7 QUALITY ASSURANCE

- A. All work shall be performed in accordance with all local and state codes, laws and regulations applicable to the work for this project. The contractor shall be responsible for all permits and costs for inspections, etc., and for checking with each utility company supplying service to this project and shall determine from them all, any changes in boxes, meters, valves, service, etc., and shall include all cost for inspections, revisions to services, etc. in his bid as required by local agencies, utilities, etc. No extra payment will be made for such items after the contractor submits his bid.
- B. In addition to all applicable Federal, State and local codes, the standards and codes listed below shall apply to all mechanical work. The reference to codes and standards shall be referenced to the latest edition or revision.
  - 1. Air Diffusion Council (ADC)
  - 2. Air Moving and Conditioning Assoc., Inc. (AMCA)
  - 3. American Boiler Manufacturer's Association (ABMA)
  - 4. American Gas Association (AGA)
  - 5. American National Standard Institute (ANSI)
  - 6. American Refrigeration Institute (ARI)
  - 7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
  - 8. American Society of Mechanical Engineers (ASME)
  - 9. American Society for Testing materials (ASTM)
  - 10. American Welding Society
  - 11. ANSI code of Pressure Piping and Unified Pressure Vessels
  - 12. ASME Boiler and Pressure Vessel Code
  - 13. Institute of Boiler and Radiator Manuf. (IBR)



14. National Electrical Manufacturer's Association (NEMA)
15. Sheet Metal & Air Conditioning contractors National Association (SMACNA)
16. Standards of the Hydraulic Institute
17. Underwriters' Laboratories (UL)
18. Williams-Steiger Occupational Safety & Health Act (OSHA)

- C. In the event of conflict between drawings, codes, standards or specifications, the most stringent requirement shall apply

#### 1.8 SUBMITTALS AND SHOP DRAWINGS

- A. Submit electronic sets of complete shop drawings for all mechanical equipment and materials associated with Division 23 and associated drawings to the Architect/Engineer for review before fabrication of work or ordering of equipment. Shop drawings shall be submitted at the earliest possible time.
- B. Shop drawings shall be first reviewed by the contractor. Inaccurate shop drawings shall be corrected by the contractor to meet specifications and schedules for this project. The contractor shall then initial the shop drawings as having been reviewed before submitting to the Architect/Engineer. Shop drawings shall have, in addition to the mechanical information, the electrical requirements for minimum circuit amperes and maximum fuse size ratings of the equipment.
- C. Drawings which are rejected must be corrected and returned for Architect/Engineer review before ordering.
- D. Furnish to the job site copies or prints of shop drawings that have been reviewed by the Engineer as soon as possible.
- E. Include a copy of each shop drawing in the Operation and Maintenance Manual.
- F. The checking and reviewing of shop drawings by the Architect/Engineer shall be construed as assisting the contractor and the Architect/Engineer's action does not relieve the contractor from the responsibility for errors or omissions which may exist thereon. The contractor shall be held responsible for errors or omissions that are discovered after approval process and must be made good by the contractor.

#### 1.9 PERMITS, INSPECTIONS AND TESTS

- A. The Mechanical Trades Contractor shall take out all permits and arrange for necessary inspections and shall pay all assessments, fees and costs, etc., and make all tests as required by applicable codes. At the completion of the project, the Mechanical Trades Contractor shall furnish certificates of inspection and approval and secure final occupancy permit. Record copies shall be included in the Operation and Maintenance manuals.

#### 1.10 RECORD DRAWINGS

- A. Maintain an up-to-date set of "record" drawings showing actual equipment, piping, duct, etc. installation locations. Exact dimensions from column lines for all concealed work and tie-ins with elevations noted shall be included.

- B. Include a set of reproducible drawings and a set of prints in each Operation and Maintenance Manual.
- C. The Engineer reserves the right to request and be furnished any additional information he deems necessary to be shown on the record drawings.

1.11 OWNER'S INSTRUCTIONS

- A. Upon completion of the project, the contractor shall be responsible for instructing the Owner's operating staff, in the presence of the Architect/Engineer's representative, in the proper operation and maintenance of the mechanical systems and equipment. Include a statement signed by the Owner that instructions have been given for proper operation and maintenance of the mechanical systems and equipment.

1.12 GUARANTEES

- A. Furnish a written guarantee, to the Architect/Engineer, that will make the contractor responsible at his own expense for any imperfections in material and/or workmanship which may develop under ordinary use within a period of one (1) year from final Owner's acceptance of the work.
- B. Furnish all written guarantees from equipment and/or material manufacturers which shall include the operating and performance conditions and capabilities upon which they are based.
- C. Permanent equipment that is used for temporary heat or cooling shall be guaranteed for one (1) year from the date of final acceptance of the project.

1.13 PORTABLE AND DETACHABLE PARTS

- A. Retain all portable and detachable parts of installation such as keys, spare accessories, operating manuals, etc. include in the Operation and Maintenance Manual.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. Furnish to the Architect/Engineer two (2) copies of an approved bound (3 ring binder) book with tabs for sections covering each item of equipment. These notebooks shall include shop drawings, maintenance manuals, operating manuals and parts lists to instruct the Owner on proper operation and use as well as maintenance for each piece of equipment. These books shall also include contractors', subcontractors' and manufacturers' names, telephone numbers and addresses.
- B. Manuals shall also include sequence of operation, control equipment literature, wiring and control diagrams, certificates of guarantees, certificates of inspection, mechanical system test and balancing reports. The contractor shall accumulate and summarize the control and maintenance sequence in a typewritten sheet to be included in the report.
- C. The manuals must be approved by the Architect/Engineer before final payment to the contractor. The Engineer reserves the right to request and be furnished any additional information that he deems necessary to be included in the manuals.

1.15 RESPONSIBILITIES FOR USE OF SUBSTITUTE MATERIALS

- A. Contractor shall notify Architect/Engineer in writing at least ten (10) calendar days before bids are due for approval to use materials and/or equipment other than that which has been specified or scheduled. If substitute materials and/or equipment are approved and used, it will be this contractor's responsibility to guarantee that the items will function as the specified equipment or materials, will in no way alter the design of the structure or system, and will not require any additional mechanical work such as piping, ductwork, etc. Any additional cost required by substitute materials will be the responsibility of the contractor.
- B. It will be the contractor's responsibility, at his own expense, to remove or replace any non-approved equipment or material or any approved equipment or materials not originally specified or scheduled if equipment and materials do not meet with the satisfaction of the Architect/Engineer.
- C. It shall be the Contractor's (Mechanical Trades) responsibility to coordinate and pay for any Electrical Contractor costs due to any changes in substitute materials and/or equipment's power requirements, which differ from that shown on the design documents.
- D. No consideration will be given to requests for substitute materials because of delivery problems unless the contractor can prove that orders were placed as soon as possible after contract was awarded and that delays were not caused by submittal of unscheduled or unspecified (substituted) materials to the Architect/Engineer.

#### 1.16 COST BREAKDOWN AND EQUIPMENT LIST

- A. The successful bidder shall be responsible for submitting a cost breakdown to the Architect/Engineer and Owner within ten (10) calendar days after date of request of the breakdown. During progress of the work, if changes occur which cause additional cost, the price on such items shall be broken down in accordance with the items listed in the breakdown.
- B. The bidders shall be responsible for submitting a complete list of all equipment manufacturers, makes, models, etc. that will be used for this project with their proposal. The equipment list shall be typed on the contractors letterhead and shall be signed by the authorized officer.

#### 1.17 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this project shall have a minimum warrantee of one (1) year. All materials and equipment shall be new, of first class quality and shall be furnished, delivered, erected, installed and finished in every detail and shall be so selected and arranged as to fit into the building space. All material or equipment that is not specified but necessary for this project shall be subject to the approval of the Architect/Engineer.
- B. Any materials or equipment not specified or scheduled but similar to that which has had prior approval shall be listed as a substitution and noted on the proposal form as such.
- C. The contractor shall include all miscellaneous materials and labor required to completely install and operate the mechanical systems as is intended by these drawings and specification.

1.18 TEMPORARY HEATING OR COOLING OF SPACE/BUILDING DURING CONSTRUCTION

- A. It is not recommended to use HVAC equipment being furnished for the project for temporary heating and cooling of the space/building during construction. If it is necessary to utilize the HVAC equipment for tempering air, filters shall be placed at face of each return diffuser or grille. Mechanical Contractor shall be responsible for removing temporary; filters at each return diffuser, cleaning return air ductwork and installing new filters within the HVAC equipment before space/building is turned over to the Owner.

1.19 SCHEDULE, COORDINATION AND INSTALLATION OF WORK

- A. The contractor shall carry on work in such a manner as to meet the dates as scheduled by the General Contractor and shall work overtime at no expense to the Owner as required to comply with the schedule. This contractor shall schedule all work with Owner and Architect/Engineer and schedule shut down of systems with Owner.
- B. Examine the site and all drawings and specifications and coordinate work with all other trades before commencing work for this project. Arrange work essentially as shown with the exact layout to be made on the job to suit actual conditions. Precise locations of equipment and materials shall be coordinated and shall be the responsibility of this contractor. Should any conflicts in location occur, and necessary deviations from drawings are required as determined by the Architect/Engineer, the contractor shall make necessary adjustments without additional cost to the Owner. Any damage to HVAC equipment due to HVAC equipment operation during construction shall be paid for by the Mechanical Contractor.
- C. All equipment, piping, ductwork, etc. shall be located and/or routed to allow for the most convenient access for servicing.
- D. Arrange for necessary access doors, panels, etc. to allow servicing of equipment, piping, valves, fire dampers, etc. Perform any cutting and patching as required, made necessary by failure to make proper arrangements.
- E. Indicated equipment connections, sizes and locations shall be verified and connected according to manufacturer's shop drawings and installation instructions. Thoroughly investigate the space provided for equipment and connections before ordering equipment. All equipment shall be selected to fit into the space allowed, including connections with adequate space allowed for operation and maintenance.
- F. All work shall be installed in a neat and workmanlike manner, using skilled personnel thoroughly qualified in the trade or duties that they are to perform. Rough work will be rejected.
- G. Coordinate all equipment deliveries and schedules to allow timely installation. Contractor shall separate equipment into sections and reassemble in building if required by the installation at no extra cost to the Owner.
- H. Furnish a superintendent approved by the Architect/Engineer to oversee and coordinate the work to be performed with all other trades.

- I. Coordinate location of pipes, ductwork, etc. with other building components such as structural components (beams, joists, columns, etc.), electrical components (lighting, conduits, etc.) and architectural components (walls, ceilings, floors, pipe chases, roof, etc.).
  - J. Before starting work, Contractor shall verify that available space for proposed pipes, ducts, equipment etc. is adequate for the intended purpose and will result in a first class installation. Irregardless of drawings, responsibility for first class operating systems rests with the Contractor.
  - K. Arrange for chases, slots, openings, etc. and other building components to allow for mechanical systems installation. Coordinate cutting and patching of these components to accommodate installation. This contractor shall be responsible for accurately locating for the general trades all chases, shafts, etc. and shall be responsible for all cutting and patching if these chases were not accurate or not coordinated in time with the general trades. Coordinate installation of all sleeves in walls, on floors or other structural or architectural components.
  - L. Sequence, coordinate and integrate installation of equipment and materials for efficient work flow during the project. Particular attention should be spent on larger pieces of equipment.
  - M. Install equipment and materials with provisions for necessary access for service and maintenance. Allow space for removal of all parts that may require replacement or servicing.
  - N. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
  - O. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. When access panels are required, valves and equipment components requiring access shall be located to minimize the number of panels.
  - P. Examine the work as it progresses and alert the Architect/Engineer in writing of any instances or obstructions that will prevent this contractor from performing his/her work.
- 1.20 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.
- 1.21 COOPERATION WITH ARCHITECT/ENGINEER AND OTHERS
- A. Coordinate all aspects of the mechanical system installation with all other trades, existing conditions, etc.
  - B. If the bidder believes that changes in design are required to meet intended design capacities and operation or material and/or equipment is obviously omitted from these specifications and drawings, the bidder shall contact the Architect/Engineer in writing at least ten (10) days before bid date. The acceptance of a bid by the Owner shall be binding and shall indicate that the bidder does not require any changes in design nor additional

costs in order to meet the design and performance of the mechanical system as indicated in these specifications and drawings.

#### 1.22 WORK INVOLVING OTHER TRADES

- A. Equipment or materials specified in Division 23 may have to be installed by other trades (such as electrical trades or architectural trades) due to code requirements or union jurisdictional requirements. Where this occurs, this contractor shall include all costs required by other trades to complete the work and hire the respective trade to perform this work.

#### 1.23 PERFORMANCE DATA AND ACCESSIBILITY

- A. All performance data specified in this specification or scheduled on drawings shall be considered actual performance of the equipment after installation. The supplier and installer shall be responsible for suitable allowances to adjust equipment to design capacities when actual operating and installation conditions differ from drawings.
- B. All equipment and materials shall be installed to allow access for servicing and maintenance. Coordinate final location of such equipment and materials that are concealed with required access doors on panels. Allow ample space for replacement or servicing. Extend all grease fittings to an accessible location.

#### 1.24 CUTTING AND PATCHING

- A. Unless noted otherwise, the Mechanical Trades shall be responsible for all cutting, patching and associated work required under Division 23. This work shall be performed by trades normally performing this type of work except drilling of holes shall be done by the contractor requiring same. This includes replacing areas of cutting required by this work with proper reinforcing, termite shielding, materials, finishing, etc. to restore the areas to their original condition, and filling all openings around ducts, piping, etc. with approved fire retardant materials. Regardless, all drilling of holes shall be the responsibility of the Contractor requiring same.
- B. If noted on drawings that the General Trades will be responsible for all cutting and patching, it will be the Mechanical Trades responsibility to notify all General Trades during bidding of all areas requiring cutting and patching. Regardless, all drilling of holes shall be the responsibility of the contractor requiring same.

#### 1.25 WORK IN EXISTING BUILDINGS

- A. Coordinate and schedule all work in existing building with Owner and Architect/Engineer. Systems shall be kept in operation at all times if at all possible. If a system shut-down is required, the contractor shall schedule with the Owner, the time and length of shut-down. A system shall not be shut down without written permission from the Owner.
- B. All existing equipment, piping, ductwork, etc. that is to be removed shall remain the property of the Owner. The contractor shall remove and locate this material that remains the property of the Owner to a location determined by the Owner somewhere on site. If the Owner does not want to maintain possession of the removed material, the contractor shall be responsible for removing material from the site and disposing of this material as

necessary to meet all codes and requirements and shall pay all costs as required for any disposal fees, inspections, permits, etc.

- C. All existing piping, equipment, etc. whether shown on drawings or not that is to be removed and/or abandoned and does not remain property of the Owner shall be removed from site.
- D. Any existing piping, valves, mechanical equipment, etc. serving the existing building which are shown or not shown on drawings and are required for systems operation shall remain in use. If these systems require relocation to allow installation of new systems, the contractor shall be responsible for relocating to an Owner and Architect/Engineer approved location. The contractor shall pay all cost for this work and include such cost in his/her bid. (As specified previously, contractor shall be responsible for examining site and include all cost for work required to complete this project.)

1.26 ACCESS TO EQUIPMENT, HEATING COILS, VALVES, ETC.

- A. Coordinate access panels with type of construction and furnish access panels in areas that are non-accessible. Access panels shall be furnished by this contractor and installed by the General Contractor. The access panels shall be all approved, UL labeled and fire rated and shall be located and sized to allow access to equipment, heating coils, valves, fire dampers, etc.
- B. Where access panels are required, valves, equipment etc. shall be located as to require the least number of access panels.

1.27 EQUIPMENT GUARDS

- A. All rotating or moving parts of equipment that are located so as to be a hazard shall be fully enclosed or properly guarded as to meet or exceed all regulations and OSHA requirements.

1.28 EQUIPMENT CONNECTIONS

- A. Connections to equipment, etc. shall be made in accordance with shop drawings, rough-in dimensions furnished by the manufacturer, codes, etc. and may vary with connections shown on drawings. The contractor shall be responsible for making connections and number of connectors as per shop drawings, codes, etc. at no additional cost to the Owner.

1.29 ELECTRICAL CONNECTIONS

- A. The Electrical Trades shall be responsible for furnishing and installing all electrical equipment, wiring, etc. required for operation of mechanical equipment unless otherwise noted on the drawings. The Mechanical Trades shall furnish detailed information and wiring diagrams to the Electrical Trades for all equipment specified and/or scheduled for this project. In the event that the Mechanical Trades furnishes an "approved equal" or "alternate" that require changes in the original electrical design, the Mechanical Trades shall pay all costs to the Electrical Trades as required to make satisfactory adjustments. All electrical work shall be done in accordance with the latest edition of the National Electric Code.

- B. See the temperature control or building automation system specification (if applicable) for description of electrical contractor work and Division 23 temperature control work.

#### 1.30 MOTORS, MOTOR STARTERS AND DISCONNECTS

- A. Unless otherwise noted on drawings, motors shall be of constant speed 1750 rpm, new NEMA Design B, 40°C rise, horse power rated, open drip-proof except TEFC in dirty atmosphere, induction type motor with service factor of 1.15 and be of sufficient capacity to continuously operate the apparatus to which it is connected under all conditions of operation without exceeding nameplate ratings.
- B. Motors shall be premium efficiency as calculated using IEEE test method 112B.
- C. Motors ½ Hp. or larger shall be three phase; motors under ½ Hp. shall be 115 volt, 60 cycle, single phase. Before ordering the motors, the contractor shall verify correct motor voltage with the Electrical Trades and field conditions.
- D. The Mechanical Trades shall furnish, for equipment under Division 23, all special switches, disconnects, starters, alternators, etc. as specified or scheduled to be factory furnished and/or factory installed with the equipment including wiring diagrams, etc. whether it is to be factory installed or field wired. All other motor starters, disconnects, etc. not noted as factory furnished shall be furnished and installed by the Electrical Trades.
- E. Starters that are to be factory furnished with equipment shall be of the combination type and shall be as specified under Electrical Trades Division. Furnish overload protection for each phase.
- F. All wiring methods and materials shall meet NEMA, National Electric Code and State of Michigan Code requirements.
- G. All displays on control panels shall be on face of the panels.
- H. Motors having V-belt shall be furnished with base slide rails or other form of adjustment.

#### 1.31 LUBRICATION AND MAINTENANCE

- A. Contractor shall maintain, oil, lubricate, etc. all equipment furnished under Division 23 until final acceptance by the Owner. Protect all bearings and shafts during installation and thoroughly grease the steel shafts to prevent corrosion. The contractor shall be responsible for any and all damage to bearings, shaft, etc. of Division 23 equipment operated or not until final acceptance by the Owner.

#### 1.33 BASES AND SUPPORTS

- A. This contractor shall be responsible for furnishing all equipment pads and supports for equipment and materials required by Division 23 unless otherwise noted on drawings.
- B. All floor mounted mechanical equipment shall have a reinforced concrete pad furnished unless otherwise noted on drawings. The concrete pads shall be tied to the building floor with expansion bolts located maximum of 4'-0" on centers with a minimum of four (4) bolts, set before pouring and concealed within the pad. The Mechanical Trades shall verify exact pad or support size with the equipment manufacturer and shall size pad with



adequate area to allow sufficient room for installation of vibration isolators, equipment mounting hardware, etc. Concrete pads shall have a 45 degree bevel at the top edge. The contractor shall verify exact location of concrete pads.

- C. Furnish all steel, hanging material, rods, etc. for suspending equipment off floor unless otherwise noted on drawings for equipment to be furnished under Division 23. This includes all structural steel for supporting between beams.
  - D. All support structure shall be of strength to safely withstand all stresses and loads to which they will be subjected and shall distribute load properly over the building area. Supports shall be designed to avoid undue strain to equipment and to avoid interference with piping, pipe connections, service and maintenance clearances, etc.
  - E. Where equipment is to be floor mounted and requires legs, this contractor shall furnish and install structural steel members or steel pipe and fittings for legs. Fasten and brace to equipment and furnish flange at base to allow bolting to floor.
  - F. Where equipment is to be ceiling or wall mounted, furnish necessary platform, structural steel, hardware, etc. as is most suitable for support of this equipment.
  - G. All supports shall be approved by the Architect/Engineer.
  - H. All piping, ductwork, etc. shall be suspended from structural steel members utilizing rods and approved hanger devices. Do not use metal deck for support. Beam clamps such as the Grinnell Fig. 260 or approved equal shall be used. Sheet metal "straps" shall not be used in place of rods.
  - I. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.
- 1.34 SLEEVES, PLATES AND COLLARS

- A. Furnish all sleeves, plates and collars for piping, ductwork, etc. passing through walls, floor ceilings, foundations, etc. Coordinate with the General Contractor the exact location and size of required openings. No pipe or duct shall pass through a wall, floor ceiling, etc. without a sleeve. This contractor shall be responsible for sleeve locations and securing sleeves before concrete is formed.
- B. Sleeves for steel pipe shall be standard weight black steel pipe. For walls, foundations and ceilings, sleeve shall be kept flush with finished surfaces. For floors, the sleeve shall be set flush with bottom of concrete construction and be extended up 1/4" above concrete floor. Sleeves shall be set in place before construction of walls, floors, ceilings, etc.

- C. Sleeves for copper pipe shall be type "M" hard copper tubing installed typical to that of steel pipe sleeves.
- D. Sleeves for piping shall be sized to allow insulation to run continuous through sleeve whenever possible and to allow not less than 1/4" all around bare pipe or insulation.
- E. Sleeves for ducts passing through floors shall be 14 gauge black steel for ducts up to 24" maximum dimension, and 12 gauge black steel for ducts 25" and over maximum dimension. Sleeves shall be kept flush with the finished wall surface.
- F. Where insulated piping passes through walls or floor sleeves, furnish 22 gauge galvanized band around insulation of same length as the sleeve length. Band shall fit snugly over insulation and be held in place by steel metal collars all around insulation to cover openings.
- G. All penetration voids shall be sealed smoke tight with non-combustible materials similar to 3M or Hilti firestop systems to maintain the integrity of the fire rated structure. In a non-fire rated assembly, seal all voids with non-hardening sealant.

#### 1.35 RIGGING AND HOISTING

- A. Perform all required rigging, hoisting, transportation, moving, etc. of all equipment, materials, etc. to be furnished and/or installed under Division 23 whether furnished by this contractor or by the Owner or other trades.

#### 1.36 STORAGE FACILITY

- A. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

#### 1.37 PROTECTION FROM DAMAGE

- A. The contractor shall be responsible for all materials, equipment, etc. and all work installed by himself and shall protect it from damage until final acceptance of this project by the Owner.
- B. Furnish all coverings and protection from dirt, dust, rain, storm, heat, traffic, wear, etc. and all possible injury including that by other workmen. Any equipment, workmanship, materials, etc. damaged prior to final acceptance by the Owner of this project shall be properly repaired at no expense to the Owner.
- C. Protect all equipment from damage by covering or coating. Any dented, scratched, rusted or marred surface finishes will not be accepted.
- D. Protect all equipment, materials, etc. from freezing.

#### 1.38 COMMON PIPE MATERIALS AND INSTALLATION INSTRUCTIONS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Refer to individual Division 23 piping Sections for special joining materials not listed below.
  - 1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
    - a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
  - 3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
  - 4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
  - 5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
  - 6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

#### 1.39 PIPE HANGERS AND SUPPORTS

- A. Hangers and saddles shall be Modern Pipe Support Corp., Grinnel/Anvil, Autogrip, or M-CO. Inserts shall be of the type to receive a machine bolt head or nut after installation, permit horizontal adjustment, and shall be flush with the surface. For copper pipe with steel hangers, clean and wrap pipe with two layers of plastic insulating tape at point of contact. Roller supports shall be adjustable type with insulated standoff. Rods shall be used for suspended installation. Sheet metal "straps" shall not be used in place of rods.
- B. Hangers for piping with vapor barrier sealed insulation shall be multipurpose pipe saddles fitting over the insulation. Wire or perforated strap iron will not be permitted for pipe supports. Do not support hangers from roof deck. Furnish and install all support steel as required to suspend from structural steel joist or beams. Hangers shall be clevis or split ring type with vertical adjustment and beam clamp similar to Grinnell/Anvil Fig. 260, with maximum spacing per ASHRAE Standards:

| Pipe Size   | Steel Pipe | Copper Pipe | PVC Pipe | Rod Size |
|-------------|------------|-------------|----------|----------|
| ½ to ¾ inch | 6 feet     | 5 feet      | 4 feet   | 3/8"     |
| 1 inch      | 7 feet     | 5 feet      | 4 feet   | 3/8"     |
| 1 ¼ inch    | 7 feet     | 7 feet      | 4 feet   | 3/8"     |
| 1½ inch     | 7 feet     | 7 feet      | 4 feet   | 1/2"     |
| 2 inch      | 10 feet    | 8 feet      | 4 feet   | 1/2"     |
| 2½ inch     | 11 feet    | 9 feet      | 4 feet   | 5/8"     |
| 3 inch      | 11 feet    | 9 feet      | 4 feet   | 5/8"     |

|          |         |         |        |      |
|----------|---------|---------|--------|------|
| 3 ½ inch | 13 feet | 11 feet | 4 feet | 5/8" |
| 4 inch   | 14 feet | 12 feet | 4 feet | 5/8" |

- C. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
  - D. Hangers for Hot Pipe Sizes ½ to 1½ Inch: Malleable iron, adjustable swivel, split ring.
  - E. Hangers for Cold Pipes sizes ½" to 1½" and Hot and Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - F. Hangers for Hot Pipe Sizes thru 4 Inches: Carbon steel, adjustable, clevis.
  - H. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - J. Wall Support for Pipe Sizes up thru 3 Inches: Cast iron hook.
  - K. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  - M. Vertical Support: Steel riser unistrut clamps at high, mid, and low locations.
  - N. Floor Support for Cold Pipe all sizes and Hot Pipe Sizes up thru 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  - Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  - R. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustments, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.
- 1.40 PIPING, DUCTWORK AND EQUIPMENT SUPPORT
- A. Attachments of mechanical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points. When routing piping or ductwork perpendicular to joist, a support shall be provided at every steel joist; when parallel to joist, a support shall be provided at no more than 6' on centers or two panel bays. Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Mechanical Trades may contact the project Structural Engineer as required for panel point location assistance and welder certification requirements. Electrical Trades are still responsible for design, layout, and fabrication and installation of electrical supports and support attachment methods. Mechanical Trades shall submit attachment methods to the Structural Engineer for review.
  - B. Install products in accordance with manufacturer's instructions.
  - C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members without permission from Architect/Engineer.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

1.41 PIPING SYSTEMS SHUT OFF VALVES

- A. Shut off valves shall be installed at all branch lines off main piping, or where mains divide/separate to serve different areas, to allow isolation of all branch piping and systems they serve such as air handling units, areas or wings of the building, etc.

1.42 CLEANING AND FINISHING

- A. During construction period, remove all debris, rubbish, tools, equipment, unused materials, etc. as required or requested by the Architect/Engineer. All cost for cleanup and removal will be the responsibility of the contractor.
- B. Upon completion of the project and before final acceptance by the Owner, the entire installation shall be thoroughly cleaned, all rubbish and unused material removed to the satisfaction of the Architect/Engineer. All dust and dirt shall be removed from all equipment, piping, ductwork, etc.
- C. Thoroughly clean all heating units, fans and fan wheels, diffusers and grilles, air handler plenums and air filter frames, etc. using compressed air if necessary.
- D. Finish paint all equipment, materials, piping, etc. as noted on drawings or listed in this specification. Match Owner's existing color scheme. Any Division 23 equipment which has been scratched or damaged shall be finished equal to the original finish.

1.43 DUCTWORK MANUAL BALANCING DAMPERS

- A. All duct branch take off's to diffusers, grilles, regulators, etc. shall have manual balancing dampers installed to allow balancing of outlets.

1.44 EQUIPMENT/SYSTEMS START-UP

- A. Furnish and schedule manufacturer's start-up service for all equipment and systems. These start-up services shall be performed in the presence of, and to the satisfaction of the Owner and Architect/Engineer.

1.45 EQUIPMENT/SYSTEMS SIGN-OFF

- A. The Mechanical Trades shall furnish written sign-offs on all systems stating that the equipment and systems have been checked, tested, started and that their operation has been verified correct through the entire range of operation that can be expected through the seasons.

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1.46 SUBSTANTIAL COMPLETION

- A. Contractor shall submit a letter to the Architect/Engineer advising that all work has been completed in accordance with plans and specifications and the project is ready for a final walk-thru.

END OF SECTION

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SECTION 23 05 16

PIPING EXPANSION COMPENSATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. MIL-E-17813D - Expansion Joints, Pipe, Bellows.

1.3 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and performing all operations required, for the correct and complete fabrication and installation of piping expansion compensation systems in accordance with the applicable project specifications, drawings, codes, regulations and standards. Expansion compensators, joints, or expansion loops may be used. Expansion loops are required unless installation area does not allow them or it is not practical.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system. Calculations and details shall be provided to the Engineer, if requested, that verify systems expansion compensation has been properly furnished and installed.
- B. Expansion Calculations:
  - 1. Installation Temperature: 50 degrees F.
  - 2. Hot Water Heating: 210 degrees F.
  - 3. Domestic Hot Water: 140 degrees F.
  - 4. Safety Factor: 30 percent.

1.5 SUBMITTALS

- A. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

- B. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.
- 1.6 WARRANTY
- A. Provide five year warranty.
  - B. Warranty: Include coverage for leak free performance of expansion joints.

## PART 2 PRODUCTS

### 2.1 FLEXIBLE PIPE CONNECTORS

- A. Steel Piping:
  - 1. Inner Hose: Stainless Steel.
  - 2. Exterior Sleeve: stainless steel.
  - 3. Pressure Rating: 125 psig WSP and 450 degrees F.
  - 4. Joint: As specified for pipe joints.
  - 5. Size: Use pipe sized units.
  - 6. Maximum offset:  $\frac{3}{4}$  inch on each side of installed center line.
  - 7. Three Victaulic flexible couplings may be used in lieu of flexible connectors for vibration attenuation. The couplings shall be placed in close proximity to the source of the vibration.
- B. Copper Piping:
  - 1. Inner Hose: Bronze
  - 2. Exterior Sleeve: Braided bronze.
  - 3. Pressure Rating: 125 psig WSP and 450 degrees F.
  - 4. Joint: As specified for pipe joints.
  - 5. Size: Use pipe sized units.
  - 6. Maximum offset:  $\frac{3}{4}$  inch on each side of installed center line.

### 2.2 EXPANSION JOINTS

- A. Stainless Steel Bellows Type:
  - 1. Pressure Rating: 125 psig WSP and 400 degrees F.
  - 2. Maximum Compression:  $1\frac{3}{4}$  inch.
  - 3. Maximum Extension:  $\frac{1}{4}$  inch.
  - 4. Joint: As specified for pipe joints.
  - 5. Size: Use pipe sized units.
  - 6. Application: Steel piping 3 inch and under.
- B. External Ring Controlled Stainless Steel Bellows Type:
  - 1. Pressure Rating: 125 psig and 400 degrees F.
  - 2. Maximum Compression:  $1\frac{1}{4}$  inch.
  - 3. Maximum Extension:  $\frac{3}{8}$  inch.
  - 4. Maximum Offset:  $\frac{5}{16}$  inch.
  - 5. Joint: Flanged.
  - 6. Size: Use pipe sized units.
  - 7. Application: Steel piping over 3 inch.
- C. Single Sphere, Flexible Compensator:
  - 1. Body: Teflon.



2. Working Pressure: 150 psi.
  3. Maximum Temperature: 400 degrees F.
  4. Maximum Compression:  $\frac{3}{4}$  inch.
  5. Maximum Elongation:  $\frac{5}{8}$  inch.
  6. Maximum Offset:  $\frac{1}{2}$  inch.
  7. Maximum Angular Movement: 15 degrees.
  8. Joint: Tapped steel flanges.
  9. Size: Use pipe sized units.
  10. Accessories: Control rods.
  11. Application: Steel piping 2 inch and over.
- D. Two-ply Bronze Bellows Type:
1. Construction: Bronze with anti-torque device, limit stops, internal guides.
  2. Pressure Rating: 125 psig WSP and 400 degrees F.
  3. Maximum Compression:  $1\frac{3}{4}$  inch.
  4. Maximum Extension:  $\frac{1}{4}$  inch.
  5. Joint: As specified for pipe joints.
  6. Size: Use pipe sized units.
  7. Application: Copper piping.
- E. Low Pressure Compensator with Two-Ply Bronze Bellows:
1. Working Pressure: 75 psig.
  2. Maximum Temperatures: 250 degrees F.
  3. Maximum Compression:  $\frac{1}{2}$  inch.
  4. Maximum Extension:  $\frac{5}{32}$  inch.
  5. Joint: Soldered.
  6. Size: Use pipe sized units.
  7. Application: Copper or steel piping 2 inch and under.
- F. Grooved end Expansion Joints:
1. Packless, gasketed, Type: 350-psig maximum, grooved ends, telescoping type expansion joint consisting of a ductile iron housing, carbon steel ends, with POPS modified PTFE slide section coating. Suitable for axial end movement to 3"/80mm. Basis of design: Victaulic Style 150.
  2. Expansion fitting consisting of a series of grooved end nipple sections joined in tandem with Victaulic flexible type couplings. Pressure rating and total joint movement dependent on pipe size and the number of couplings used in the joint. Basis of design: Victaulic Series 155.
- ## 2.3 EXPANSION LOOPS
- A. Piping expansion loops shall be sized and installed in accordance with standards and codes for amount of piping expansion required by the piping system. The Mechanical Trades will be responsible for calculations, detailing and installation of loops, guides and anchors.
- B. For water systems, Victaulic flexible couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops (as approved by the engineer). Where loops are required, install loops in grooved-end steel piping systems consisting of (8) Victaulic flexible couplings, (4) 90 degree elbows, and (3) grooved end pipe spools in accordance with Victaulic recommendations for expansion compensation

## 2.4 ACCESSORIES

- A. Pipe Alignment Guides:
  - 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.
- B. Swivel Joints:
  - 1. Bronze body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Construct spool pieces to exact size of flexible connection for future insertion.
- C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- G. If Victaulic pipe system is used, provide pipe guides as recommended by expansion joint manufacturer, or four (4) pipe diameters from the expansion joint to the first guide and fourteen (14) pipe diameters between guides to the second joint.
- H. Provide Victaulic piping with minimum one joint per (inch) pipe diameter instead of flexible connector supported by vibration isolation. Victaulic piping need not be anchored.
- I. Provide expansion loops as indicated on drawings and as required to compensate for piping expansion.

### 3.2 MANUFACTURER'S FIELD SERVICES

- A. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

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SECTION 23 05 19  
GAGES AND METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Positive displacement meters.
- B. Pressure gages and Pressure gage taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gages.
- E. Filter gages.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ASME - B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASTM E1 - Specification for ASTM Thermometers.
- C. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- D. AWWA C700 - Cold Water Meters - Displacement Type.
- E. AWWA C701 - Cold Water Meters - Turbine Type for Customer Service.
- F. AWWA C702 - Cold Water Meters - Compound Type.
- G. AWWA C706 - Direct Reading Remote Registration System for Cold Water Meters.
- H. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.3 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and performing all operations required, for the correct and complete fabrication and installation of gages and meters in accordance with the applicable project specifications, drawings, codes, regulations and standards.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

## 2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register.
  - 1. Meter: Brass body turbine meter with magnetic drive register.
  - 2. Service: cold water, 122 degrees F hot water, 200 degrees F.
  - 3. Accuracy: 1½ percent.
  - 4. Maximum Counter Reading: 10 million gallons (liters).
  - 5. Size: ¾ inch.

## 2.2 PRESSURE GAGES

- A. Gage: ASME B40.1, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - 1. Case: Steel with brass bourdon tube.
  - 2. Size: 4½ inch diameter.
  - 3. Mid-Scale Accuracy: One percent.
  - 4. Scale: psi.

## 2.3 PRESSURE GAGE ACCESSORIES

- A. Gage Cock: Ball valve.
- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch connection.
- C. Siphon: ¼ inch angle or straight pattern.

## 2.4 STEM TYPE THERMOMETERS

- A. Thermometer: ASTM E1, adjustable angle, liquid-in-glass, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
  - 1. Size: 9 inch scale.
  - 2. Window: Acrylic.
  - 3. Stem: die-cast zinc, length to suit.
  - 4. Accuracy: ASTM E77 1 percent.
  - 5. Calibration: Both degrees F and degrees C.
  - 6. Tube: Non-toxic, blue-reading organic filled, magnifying lens front.

## 2.5 DIAL THERMOMETERS

- A. Thermometer: ASTM E1, stainless steel case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer glass lens.
  - 1. Size: 4½ inch.
  - 2. Lens: Clear glass Lexan.
  - 3. Length of Capillary: Minimum 5 feet.
  - 4. Accuracy: 2 percent.
  - 5. Calibration: Both degrees F and degrees C.

## 2.6 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.7 TEST PLUGS

- A. Test Plug: Similar to Petes Plug, ¼ inch or ½ inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel or Viton core for temperatures up to 275 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing two 3 ½ inch diameter pressure gages, two gage adapters with 1/8 inch probes, two 1 ½ inch dial thermometers.

## 2.8 STATIC PRESSURE GAGES

- A. 3½ inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, ¼ inch diameter tubing.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2½ inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets, where thermometers are provided on local panels.

- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, and adjacent to control device sockets.

END OF SECTION

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SECTION 23 05 48

VIBRATION ISOLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation.

1.2 CONCRETE FURNISHED AND INSTALLED BY OTHERS

- A. All concrete shall be furnished and installed by the General Contractor unless otherwise noted on drawings.
- B. This contractor shall be responsible for coordinating all concrete work with the general trades during bidding (includes equipment, pads, etc.).

1.3 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.
- B. Provide minimum static deflection of isolators for equipment as indicated.
  - 1. Basement, Under 20 hp
    - a. Under 400 rpm: 1 inch
    - b. 400 - 600 rpm: 1 inch
    - c. 600 - 800 rpm: 0.5 inch
    - d. 800 - 900 rpm: 0.2 inch
    - e. 1100 - 1500 rpm: 0.14 inch
    - f. Over 1500 rpm: 0.1 inch
  - 2. Basement, Over 20 hp
    - a. Under 400 rpm: 2 inch
    - b. 400 - 600 rpm: 2 inch
    - c. 600 - 800 rpm: 1 inch
    - d. 800 - 900 rpm: 0.5 inch
    - e. 1100 - 1500 rpm: 0.2 inch
    - f. Over 1500 rpm: 0.15 inch
  - 3. Upper Floors, Normal
    - a. Under 400 rpm: 3.5 inch
    - b. 400 - 600 rpm: 3.5 inch
    - c. 600 - 800 rpm: 2 inch
    - d. 800 - 900 rpm: 1 inch
    - e. 1100 - 1500 rpm: 0.5 inch
    - f. Over 1500 rpm: 0.2 inch
  - 4. Upper Floors, Critical
    - a. Under 400 rpm: 3.5 inch
    - b. 400 - 600 rpm: 3.5 inch
    - c. 600 - 800 rpm: 3.5 inch
    - d. 800 - 900 rpm: 2 inch
    - e. 1100 - 1500 rpm: 1 inch

- f. Over 1500 rpm: 0.5 inch

- C. Upper floor locations shall be considered critical unless otherwise indicated.

## PART 2 PRODUCTS

### 2.1 VIBRATION ISOLATORS

#### A. Open Spring Isolators:

- 1. Spring Isolators:
  - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - b. Code: Color code springs for load carrying capacity.
- 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- 3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
- 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

#### B. Restrained Spring Isolators:

- 1. Spring Isolators:
  - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - b. Code: Color code springs for load carrying capacity.
- 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- 3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
- 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- 5. Restraint: Provide heavy mounting frame and limit stops.

#### C. Closed Spring Isolators:

- 1. Spring Isolators:
  - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - b. Code: Color code springs for load carrying capacity.
- 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

#### D. Restrained Closed Spring Isolators:

- 1. Spring Isolators:
  - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - b. Code: Color code springs for load carrying capacity.
- 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.



3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
  4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
- E. Spring Hanger:
1. Spring Isolators:
    - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
    - b. Code: Color code springs for load carrying capacity.
  2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
  3. Housings: Incorporate [neoprene isolation pad meeting requirements for neoprene pad isolators] [rubber hanger with threaded insert].
  4. Misalignment: Capable of 20 degree hanger rod misalignment.
- F. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
    - a. 30 durometer.
    - b. Minimum ½ inch thick.
    - c. Maximum loading 40 psi.
    - d. Height of ribs shall not exceed 0.7 times width.
- G. Configuration: ½ inch thick waffle pads bonded each side of ¼ inch thick steel plate.
- H. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.
- I. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- J. Seismic Snubbers:
1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
  2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
  3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
  4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions. See drawings for types of vibration isolation required.
- B. Install isolation for motor driven equipment.
- C. Bases:
  1. Set steel bases for one inch clearance between housekeeping pad and base.
- D. Adjust equipment level.

- E. Install spring hangers without binding.
- F. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- G. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- H. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- I. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector.
- J. Connect wiring to isolated equipment with flexible hanging loop.

### 3.2 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

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SECTION 23 05 53

HVAC IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI or equal standards for the Identification of Piping Systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Furnish and install on all mechanical equipment.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1½ inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. ¾ to 1¼ inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ½ inch high letters.
  - 2. 1½ to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ¾ inch high letters.
  - 3. 2½ to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1¼ inch high letters.
  - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2½ inch high letters.
  - 5. Ductwork and Equipment: 2½ inch high letters.
- B. Stencil Paint shall be semi-gloss enamel, colors conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color: Match existing or conform to ANSI/OSHA standards.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## 2.5 CEILING TACKS

- A. Description: Steel with  $\frac{3}{4}$  inch diameter color coded head.
- B. Color code as follows:
  - 1. Yellow - HVAC equipment
  - 2. Red - Fire dampers/smoke dampers
  - 3. Green - Plumbing valves
  - 4. Blue - Heating/cooling valves

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as required by manufacturer's installations for stencil painting.

### 3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify each piece of equipment with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify thermostats relating to terminal boxes or valves with nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.

- J. Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- M. Identify access points at the exterior of all fire, smoke, or combination fire/smoke dampers with a permanent label, having letters not less than ½" in height, reading fire damper, smoke damper or fire/smoke damper respectively.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 RELATED SECTIONS AND DRAWINGS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

- A. Submit electronic draft copies of report for review prior to final acceptance of Project. Provide electronic final copies for Architect/Engineer review and for inclusion in operating and maintenance manuals.
- B. Provide reports in 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. Binder shall be high quality hard cover type.
- C. Include detailed procedures, agenda, sample report forms and copy of NEBB Project Performance Guaranty prior to commencing system balance.

- D. Test Reports: Indicate data on AABC National Standards for Total System Balance forms or forms approved in writing by Architect/Engineer.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow measuring stations and/or balancing valves and rough setting.

#### 1.6 QUALITY ASSURANCE

- A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. Maintain one copy of each document on site.
- C. The final air balance report shall be approved by the Architect/Engineer prior to final payment to the Contractor. The Engineer reserves the right to ask for and be furnished any additional information he deems necessary to be shown on air/water balance report.

#### 1.7 QUALIFICATIONS

- A. Agency: Independent company (not associated with the systems installing contractor) specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience and NEBB certified. The test and balance agency selected by the Contractor shall be approved by the Engineer. The Mechanical Trades shall be responsible for any cost differences between the test and balance agency selected by the Contractor and the test and balance agency approved by the Engineer.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. Coordinate project schedule with contractor. The Mechanical Trades shall coordinate and schedule the on-site balancing with the Engineer to allow the Engineer the ability to be at the project site during the time of the balancing. If the Engineer is not scheduled to oversee the balance of systems, the Mechanical Trades shall be responsible for rebalancing the system in the presence of the Engineer and be responsible for all costs for such.
- B. The Test and Balance Agency shall schedule/coordinate (through the Mechanical Contractor) with the Temperature Control Contractor. The Temperature Control Contractor should be on site during the air balance to verify proper operation of the system required for the air balance.
- C. Acceptable Test and Balance Contractors.
  - 1. HiTech Test and Balance (Freeland, MI)
  - 2. Absolute Balance Company (South Lyon, MI)
  - 3. Enviro-Aire/Total Balance Company (St Clair Shores, MI)
  - 4. Ener-Tech Testing (Holly, MI)
  - 5. International Test & Balance (Southfield, MI)

### PART 2 PRODUCTS

Not used

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Hydronic systems are flushed, filled, and vented.
  - 13. Pumps are rotating correctly.
  - 14. Proper strainer baskets are clean and in place.
  - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

### 3.2 PREPARATION

- A. Provide a review of proposed design drawings and advise appropriate trades about additional balancing devices required to attain design conditions.
- B. Advise Engineer about additional balancing devices required to attain design conditions.
- C. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

### 3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply, return and exhaust systems.
- B. Air Outlets and Inlets: Adjust to within plus 10 percent and minus 5 percent of design and to Owner's satisfaction. Respond to Owner complaints of unsatisfactory room temperatures by adjusting outlets and/or inlets to more or less air as required.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.4 ADJUSTING



- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

### 3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities. The air balance agency shall be responsible for removing all adjustable motor pulleys and replacing them with fixed motor pulleys after air balancing the system. Include costs for all air systems to be readjusted to required air volumes. Pitot duct mains at supply air and return air ducts at air handling systems and exhaust fans to verify air quantity at units vs. at diffusers and grilles.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices at outlets to regulate air quantities so that outlets do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On VAV boxes, adjust for proper operation.
- P. Advise Mechanical Contractor about additional balancing devices required to attain design conditions.
- Q. Adjust adjustable pitch sheaves to setting as required by actual conditions. If sheave size or type changes are recommended, include the recommendation in the draft copy of the report to allow the Owner to be informed of, and be responsible for, the recommendation for the change.

### 3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balanced point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Advise Mechanical Contractor about additional balancing devices required to attain design conditions.

- H. If pump impellor trimming or size change is recommended to improve reliability or reduce operating cost, include the recommendation in the draft copy of the report, to allow the Owner to be informed of, and be responsible for, the recommendation for the change.

### 3.7 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing shall include but not be limited to: Air moving equipment such as exhaust fans, air handlers, return fans, etc.; terminal devices such as grilles and diffusers, variable air volume boxes, etc.; all hydronic systems such as pumps, chillers, flow control valves, coils, etc. See drawings for equipment utilized for this project and submit applicable report forms for this project air and/or water system(s).
- B. Report Forms
  - 1. Title Page:
    - a. Name of Testing, Adjusting, and Balancing Agency
    - b. Address of Testing, Adjusting, and Balancing Agency
    - c. Telephone number of Testing, Adjusting, and Balancing Agency
    - d. Project name
    - e. Project location
    - f. Project Architect
    - g. Project Engineer
    - h. Project Contractor
    - i. Project altitude
    - j. Report date
  - 2. Summary Comments:
    - a. Design versus final performance
    - b. Notable characteristics of system
    - c. Description of systems operation sequence
    - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
    - e. Nomenclature used throughout report
    - f. Test conditions
  - 3. Instrument List:
    - a. Instrument
    - b. Manufacturer
    - c. Model number
    - d. Serial number
    - e. Range
    - f. Calibration date
  - 4. Electric Motors:
    - a. Manufacturer
    - b. Model/Frame
    - c. HP/BHP
    - d. Phase, voltage, amperage; nameplate, actual, no load
    - e. RPM
    - f. Service factor
    - g. Starter size, rating, heater elements
    - h. Sheave Make/Size/Bore
  - 5. V-Belt Drive:
    - a. Identification/location
    - b. Required driven RPM

- c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
  - a. Identification/number
  - b. Manufacturer
  - c. Size/model
  - d. Impeller
  - e. Service
  - f. Design flow rate, pressure drop, BHP
  - g. Actual flow rate, pressure drop, BHP
  - h. Discharge pressure
  - i. Suction pressure
  - j. Total operating head pressure
  - k. Shut off, discharge and suction pressures
  - l. Shut off, total head pressure
  - m. Heat output
- 7. Air Cooled Condenser:
  - a. Identification/number
  - b. Location
  - c. Manufacturer
  - d. Model number
  - e. Serial number
  - f. Entering DB air temperature, design and actual
  - g. Leaving DB air temperature, design and actual
  - h. Number of compressors
- 8. Cooling Coil Data:
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air DB temperature, design and actual
  - g. Entering air WB temperature, design and actual
  - h. Leaving air DB temperature, design and actual
  - i. Leaving air WB temperature, design and actual
  - j. Water flow, design and actual
  - k. Water pressure drop, design and actual
  - l. Entering water temperature, design and actual
  - m. Leaving water temperature, design and actual
  - n. Saturated suction temperature, design and actual
  - o. Air pressure drop, design and actual
- 9. Heating Coil Data:
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Water flow, design and actual
  - g. Water pressure drop, design and actual
  - h. Entering water temperature, design and actual

- i. Leaving water temperature, design and actual
  - j. Entering air temperature, design and actual
  - k. Leaving air temperature, design and actual
  - l. Air pressure drop, design and actual
- 10. Electric Duct Heater:
  - a. Manufacturer
  - b. Identification/number
  - c. Location
  - d. Model number
  - e. Design kW
  - f. Number of stages
  - g. Phase, voltage, amperage
  - h. Test voltage (each phase)
  - i. Test amperage (each phase)
  - j. Air flow, specified and actual
  - k. Temperature rise, specified and actual
- 11. Air Moving Equipment:
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Air flow, specified and actual per pitot readings at equipment and per totaled outlets.
  - g. Return air flow, specified and actual per pitot readings at equipment and per totaled inlets.
  - h. Outside air flow, specified and actual per pitot.
  - i. External and total static pressure, specified and actual
  - j. Inlet pressure
  - k. Discharge pressure
  - l. Sheave Make/Size/Bore
  - m. Number of Belts/Make/Size
  - n. Fan RPM
- 12. Return Air/Outside Air Data:
  - a. Identification/location
  - b. Design return air flow
  - c. Actual return air flow per pitot readings at equipment and per totaled grilles air flow measurement
  - d. Design outside air flow
  - e. Actual outside air flow per pitot readings
  - f. Return air temperature
  - g. Outside air temperature
  - h. Required mixed air temperature
  - i. Actual mixed air temperature
  - j. Design outside/return air ratio
  - k. Actual outside/return air ratio
- 13. Exhaust Fan Data:
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Air flow, specified and actual per pitot readings at exhaust fan and per totaled exhaust grilles or duct inlets.
  - f. Static pressure, specified and actual

- g. Inlet pressure
  - h. Discharge pressure
  - i. Sheave Make/Size/Bore
  - j. Number of Belts/Make/Size
  - k. Fan RPM
- 14. Duct Traverse:
  - a. System zone/branch and at all equipment (AHUs, RTUs, EFs, etc.)
  - b. Duct size
  - c. Area
  - d. Design velocity
  - e. Design air flow
  - f. Test velocity
  - g. Test air flow
  - h. Duct static pressure
  - i. Air temperature
  - j. Air correction factor
- 15. Duct Leak Test:
  - a. Description of ductwork under test
  - b. Duct design operating pressure
  - c. Duct design test static pressure
  - d. Duct capacity, air flow
  - e. Maximum allowable leakage duct capacity times leak factor
  - f. Test apparatus
    - 1) Blower
    - 2) Orifice, tube size
    - 3) Orifice size
    - 4) Calibrated
  - g. Test static pressure
  - h. Test orifice differential pressure
  - i. Leakage
- 16. Terminal Unit Data:
  - a. Manufacturer
  - b. Type, constant, variable, single, dual duct
  - c. Identification/number
  - d. Location
  - e. Model number
  - f. Size
  - g. Minimum static pressure
  - h. Minimum design air flow
  - i. Maximum design air flow
  - j. Maximum actual air flow
  - k. Inlet static pressure
- 17. Air Distribution Test Sheet:
  - a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow

- j. Percent of design air flow
- 18. Sound Level Report:
  - a. Location
  - b. Octave bands-equipment off
  - c. Octave bands-equipment on
- 19. Vibration Test:
  - a. Location of points:
    - 1) Fan bearing, drive end
    - 2) Fan bearing, opposite end
    - 3) Motor bearing, center (if applicable)
    - 4) Motor bearing, drive end
    - 5) Motor bearing, opposite end
    - 6) Casing (bottom or top)
    - 7) Casing (side)
    - 8) Duct after flexible connection (discharge)
    - 9) Duct after flexible connection (suction)
  - b. Test readings:
    - 1) Horizontal, velocity and displacement
    - 2) Vertical, velocity and displacement
    - 3) Axial, velocity and displacement
  - c. Normally acceptable readings, velocity and acceleration
  - d. Unusual conditions at time of test
  - e. Vibration source (if non-complying)

END OF SECTION

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SECTION 23 07 13

EXTERNAL DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES EXTERNAL INSULATION FOR:

- A. Supply air ducts. Note: See drawings or Section 230825, internal duct cover, for notes on whether the supply air ductwork downstream of VAV boxes is to be insulated. If drawings or Section 230825 call for internal duct insulation, delete external duct insulation downstream of the VAV box.
- B. Outside air intake ducts.
- C. Ducts located outdoors.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:
  - 1. American Society for Testing of Materials and Specifications:
    - a. ASTM C533, "Standard Specification for Calcium Silicate Pipe and Block Insulation"
    - b. ASTM C553, "Standard Specification for Mineral Fiber Blanket and Felt Insulation"
    - c. ASTM C612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"
    - d. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only)
- B. Insulation materials, including all weather and vapor barrier material, closures, hangers, supports, fitting covers, and other accessories shall be furnished and installed in strict accordance with project drawings, plans and specifications.

1.4 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and performing all operations required, for the correct fabrication and installation of thermal insulation applied to commercial ductwork systems in accordance with the applicable project specifications, and drawings, subject to the terms and conditions of the contract.



- B. The above temperature ranges are typical for these systems. However, if contract specifications call for service temperatures outside the above ranges, consult the manufacturer's published data to determine the operating temperature limitations of the insulation products or products under consideration.

#### 1.5 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state with or without binder.
- B. Exposed ductwork shall include ductwork installed in areas used by personnel in the normal use of the building, such as finished work rooms, offices, mechanical rooms, storage rooms, etc.
- C. Exposed finished areas include areas that normally have finished walls, ceilings, floors, etc. such as offices.
- D. Concealed ductwork shall include ductwork installed in areas similar to pipe tunnels, covered pipe trenches, spaces inside walls, duct or pipe shafts, spaces above dropped ceilings, unfinished attic spaces, crawl spaces, etc.

#### 1.6 SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturer's Association (NAIMA) (Formerly known as TIMA), to ensure cost effective energy conservation performance. Alternatively, materials should exceed the minimum thickness requirements of National Voluntary Consensus Standard 90.1 (1989), energy Efficient Design of New Buildings", of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.
- B. Insulation materials furnished and installed hereunder shall be Class A, maximum of 25 flame spread, 35 fuel contributed and 50 smoke developed rating and shall meet the fire hazard requirements of the following specifications:
  - 1. American Society for Testing of Materials ASTM E84
  - 2. Underwriter's laboratories, Inc. UL 723
  - 3. National Fire Protection Association NFPA 255
- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

#### 1.7 QUALITY ASSURANCE

- A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

## 1.8 DELIVERY AND STORAGE OF MATERIALS

- A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation materials shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- C. If any insulation material has become wet the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

## PART 2 PRODUCTS

### 2.1 DUCTWORK AND STACKS LOCATED INDOORS

- A. Ductwork shall be externally insulated with Fiberglas insulation in blanket, batt or board form, selected to conform readily to the surface to which it will be applied. Vapor barrier shall be legibly printed by the manufacturer to indicate nominal thickness, R-value and type of insulation. External insulation shall be as follows:

#### 1. Concealed Ductwork

- a. Rectangular, round or oval ductwork: Fiberglas All-Service duct wrap, light density glass fiber insulation in roll form, 1½" thick, 1.0 lb per cubic foot density, faced with a reinforced foil/kraft laminate vapor barrier. All joints shall be stapled with outward clinching staples and where a vapor barrier is required, sealed with pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping.

#### 2. Exposed Rectangular Ductwork

- a. Rectangular: Fiberglas type 705, 2" thick, 3.0 lbs per cubic foot density insulation, heavy density glass fiber insulation in semi-rigid or rigid board form, faced with reinforced foil/kraft laminate vapor barrier. All joints shall be stapled with outward clinching staples and where a vapor barrier is required, sealed with pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping.

#### 3. Exposed Round or Oval Ductwork

- a. Cross Section less than 10" diameter: Fiberglas all-service duct wrap, 1½" thick, 1.5 lb per cubic foot density, with FSK foil face. All joints shall be stapled with outward clinching staples and where a vapor barrier is required, sealed with

pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping. If installed in high abuse areas like gymnasiums or locker rooms, use 1" thick elastomeric with foil type wrap (similar to Venture Clad Plus).

- b. Cross section 10" or more in diameter: Fiberglas, Pipe and Tank Insulation, heavy density glass 1½" thick 4.5 lb per cubic foot density, semi-rigid insulation, end grain factory-adhered to ASJ all-service jacket. All joints shall be stapled with outward clinching staples where a vapor barrier is required, sealed with pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping.

#### 4. Ductwork Located Outdoors

- a. All ductwork (supply, return, exhaust, outside air, relief air) located outdoors shall be covered externally with either 2" of flexible elastomeric closed-cell insulation or 2" of Foamglas® closed cell insulation.
- b. Installation shall meet manufacturer's recommendations, with all joints firmly butted and secured with adhesives or fasteners.
- c. All ductwork insulation shall be jacketed with a multi-ply, fabric reinforced, self-adhesive insulation cladding material with a vapor barrier and a thickness of 0.015". Jacketing system shall be Venture Clad Plus #1579CW-E, or equal.
- d. Install all insulation and jacketing in accordance with manufacturer's installation instructions.
- e. Rectangular ductwork shall be installed with a crown or slope on top to prevent water from ponding. Insulation and jacketing shall be installed on top of duct and crown or slope shim.
- f. Jacketing shall be installed to each of the sides separately, starting with bottom, then sides and finally the top. Each side shall overlap the other by 3". The sides shall overlap the bottom and the top shall overlap the sides.
- g. All jacketing seams must be taped with manufacturer's recommended jointing/seaming tape.
- h. All underlying foil faced insulation must be sealed with foil or FSK tape.

### PART 3 EXECUTION

#### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.2 PREPARATION

- A. Ensure that all seams and joints in ductwork have been sealed by the contractor responsible for duct systems.
- B. Ensure that pressure testing of duct systems has been completed prior to installing insulation.
- C. Ensure that all duct surfaces over which or within which insulation is to be installed are clean and dry.
- D. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

### 3.3 INSTALLATION

#### A. General

- 1. Install insulation in accordance with manufacturer's published instructions and recognized industry practice to ensure that it will serve its intended purpose.
- 2. Install insulation materials with smooth and even surfaces. Butt joints firmly together to ensure complete and tight fit over surfaces to be covered.
- 3. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. All staples used on ductwork insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

#### B. Penetrations

- 1. Extend ductwork insulation without interruption through walls, floors etc., except at fire dampers or unless noted otherwise.

#### C. Duct Wrap Insulation

- 1. Insulation shall be applied to sheet metal ductwork or plenums with all joints butted firmly together, using manufacturer's recommended stretch-out tables (see Owens-Corning Pub. No. 3-MS-9266) to prevent excessive compression. Insulation shall be secured with mechanical fasteners spaced at 16" maximum centers on the bottom of 24" or wider ducts to prevent the insulation from sagging.
- 2. All joints shall be firmly butted together and where a vapor barrier is required, sealed with pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping.

D. Rigid Insulation

1. Board shall be secured to ductwork with adhesive or with mechanical fasteners with welded pins, secured with insulation caps and washers matching color of the vapor barrier facing. If used, mechanical fasteners shall be within 3" (max.) of board edges, 12" maximum on center.
2. All joints shall be firmly butted together and where a vapor barrier is required, sealed with pressure sensitive tape matching the facing, FRK backing stock or glass fabric and mastic. Adjacent sections shall be tightly butted with the 2" tape flap overlapping.
3. Corner angles shall be installed on all external corners of rigid duct insulation in exposed finished areas before jacketing, except kitchen hood exhaust duct insulation which shall have no corner angles.

3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. Protect the insulation work during the remainder of the construction period to avoid damage and deterioration of the finished insulation work.

3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.7 ASBESTOS INSULATION

- A. Any existing asbestos insulation on existing ductwork, equipment, etc. where tie-ins are required, shall be removed by the Owner at the Owner's expense. The Contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

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SECTION 23 07 14

INTERNAL ACOUSTICAL DUCT LINING

PART 1 GENERAL

1.1 SECTION INCLUDES INTERNAL ACOUSTICAL DUCT LINING FOR:

A. Supply Air Duct

1. Downstream of volume box.
2. Within 20 feet of the air handling unit.

B. Return Air Duct

1. Within 20 feet of the air handling unit or return air fan.

C. Mixed Air Duct

1. Within 20 feet of the air handling unit.

D. Outside Air Duct

E. Exhaust Air Duct

1. Within 20' of the fan.

1.2 REFERENCES

A. Acoustical duct lining materials shall meet the property requirements of the following specifications as applicable to the specific product or end use:

1. Blanket and board
  - a. UL 723 and ASTM E84-75: Surface burning characteristics flame spread less than 25, smoke developed less than 50.
  - b. ASTM C518-70: Thermal Conductivity.
  - c. ASTM C423-66: Absorption Coefficients.
  - d. ASTM C1071.
  - e. NFPA 90A.

B. Duct lining materials, including all accessories shall be furnished and installed in strict accordance with project drawings, plans and specifications.

1.3 DEFINITIONS

A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state with or without binder.

1.4 SYSTEM PERFORMANCE

- A. Acoustical materials furnished and installed hereunder shall be Class A, maximum of 25 flame spread, 35 fuel contributed, and 50 smoke developed rating.

## 1.5 QUALITY ASSURANCE

- A. Materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.
- B. Materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

## PART 2 PRODUCTS

### 2.1 ACOUSTICAL LINING

- A. Acoustical Lining shall be in blanket or board form, selected to conform readily to the surface to which it will be applied.
  - 1. Fiberglas duct liner in blanket or board form, 1" thick, 1.5 lb. density with a fire-resistant coating to bond the fibers of the airstream surface and rated for air velocity of 5,000 fpm minimum.

### 2.2 ACCESSORY MATERIALS

- A. Accessory materials installed as part of work under this section shall include (but not be limited to):
  - 1. Adhesives.
  - 2. Fasteners, weld pins/studs, speed clips, insulation washers.

## PART 3 EXECUTION

### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.2 PREPARATION

- A. Ensure that all seams and joints in ductwork have been sealed by the contractor responsible for the duct systems.

- B. Ensure that pressure testing of duct systems has been completed prior to installing insulation.
- C. Ensure that all duct surfaces over which or within which insulation is to be installed are clean and dry.
- D. Ensure that material is clean, dry, in good mechanical condition, and undamaged. Wet, dirty, or damaged material shall not be acceptable for installation.

### 3.3 INSTALLATION

#### A. General

- 1. Install lining in accordance with manufacturer's published instructions and recognized industry practice to ensure that it will serve its intended purpose.

#### B. Duct Lining

- 1. All airstream surfaces of ducts, plenums, housings, and air shafts designated to receive lining shall be completely covered with lining adhered with 90% minimum coverage of adhesive meeting. All leading edges and transverse joints shall be adhesive-coated. If air velocities exceed 4000 FPM, metal nosing shall be used on all transverse leading edges. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. Install lining with smooth and even surfaces. The duct liner shall be additionally secured with weld secured mechanical fasteners which shall compress the duct liner sufficiently to hold it firmly in place. Mechanical fasteners shall be spaced in accordance with manufacturer's published schedule for the applicable interior plenum, housing or shaft width.

### 3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all work covered by this specification, visually inspect the work and verify that it has been correctly installed.

### 3.5 PROTECTION

- A. Replace damaged work which cannot be satisfactorily repaired.
- B. Protect the work during the remainder of the construction period, to avoid damage and deterioration of the finished work.

### 3.6 SAFETY PRECAUTIONS

- A. Contractor's employees shall be properly protected during the course of all work. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.



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MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

3.7 ASBESTOS INSULATION

- A. Any existing asbestos insulation on existing ductwork, equipment, etc. where tie-ins are required, shall be removed by the Owner at the Owner's expense. The Contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

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SECTION 23 07 16

MISCELLANEOUS EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulation of miscellaneous equipment such as storage tanks, air separators, chilled water pump impellor housings, etc. and any other miscellaneous items that drawings call for to be insulated.

1.2 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:
  - 1. American Society for Testing of Materials Specifications:
    - a. ASTM C533, "Standard Specification for Calcium Silicate Pipe & Block Insulation"
    - b. ASTM C533, "Standard Specification for Mineral Fiber Blanket and Felt Insulation"
    - c. ASTM C612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"
    - d. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only).
- B. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories shall be furnished and installed in strict accordance with project drawings, plans and specifications.

1.3 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following commercial systems, in accordance with applicable project specifications and drawings, subject to the terms and conditions of the contract:
  - 1. Hot systems, fluid systems, 105°F and up
  - 2. Cold systems, fluid temperatures below 105°F

1.4 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state with or without binder.

1.5 SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) (formerly known as TIMA), to ensure cost-effective energy

conservation performance. Alternatively, materials should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1 (1989), "Energy Efficient Design of New Buildings", of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

1. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of any one of the following specification:
  - a. American Society for Testing of Materials      ASTM E84
  - b. Underwriters' Laboratories, Inc.      UL 723
  - c. National Fire Protection Association      NFPA 255

- B. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

## 1.6 QUALITY ASSURANCE

- A. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

## PART 2 PRODUCTS

### 2.1 VESSELS, TANKS AND EQUIPMENT

- A. Vessels, tanks, and equipment operating at temperatures up to 450°F shall be insulated with glass fiber or calcium silicate insulation selected to conform readily to the surface to which it will be applied.
- B. For temperatures over +400°F, insulation shall be applied in double layers, staggering the joints of both the insulation and the lagging (if used) wherever practical. Observe manufacturer recommendations on maximum temperature/ thickness combinations, but should not be less than that specified for the piping system it is associated with. Outdoor installations require weather protection of insulation jacketing. Insulation may be one of the following type, depending on project requirements:
  1. Small diameter tanks and vessels with diameters less than 30" in diameter may be insulated with any of the following, depending on the service class required.
    - a. Heavy density Fiberglas pipe insulation with factory applied all service jacket (ASJ) and Doublesure\* two-component adhesive closure system, rated for a

maximum service temperature of 850°F. For large pipe sizes where SSL-II is not available, the single adhesive SSL closure may be substituted.

- b. Unjacketed Fiberglas heavy density pipe insulation rated for maximum operating temperature of 850°F may be installed using appropriate banding and then covered with metal or PVC jacketing or otherwise jacketed and/or finished in accordance with details shown.
  - c. Owens-Corning Fiberglas pipe and tank insulation, heavy density fiberglass insulation with end-grain factory-applied to ASJ all-service jacket, for systems operating at temperatures to +650°F and where moderate abuse resistance is required.
  - d. Owens-Corning Pink Calcium Silicate, rigid hydrous asbestos-free calcium silicate insulation for systems operating at temperatures from +300°F to +1200°F, where the equipment is expected to be exposed to impact or abuse. The insulation shall be protected from the effects of weather, water, moisture, or mechanical and chemical abuse with either metal or PVC jacketing or otherwise jacketed and/or finished in accordance with details shown.
2. Tanks and vessels over 30" in diameter may be insulated with any of the following, depending on the service class required:
- a. For indoor service at operating temperatures to +250°F, round or rectangular tanks or vessels: Fiberglas all-service duct wrap, light density glass fiber insulation in roll form, faced with a reinforced foil/kraft laminate, meeting the requirements of specification ASTM C553.
  - b. For indoor/outdoor service at operating temperatures to +450°F on rectangular equipment: Fiberglas 700 Series insulation, heavy density glass fiber insulation in semi-rigid or rigid board form, unfaced or with ASJ or FRK facing, meeting the requirements of ASTM C612. For concealed areas, Type 703 may be used. For exposed and outdoor applications, Type 705 shall be used.
  - c. For service at operating temperatures to +650°F, rectangular, round, or oval cross-section, and/or where moderate abuse resistance is required: Fiberglas pipe and tank insulation, heavy density glass fiber insulation in roll form, end-grain factory-adhered to an ASJ all-service jackets.
  - d. For application involving operating temperatures over +300°F and requiring a rigid insulation with high abuse resistance: Owens-Corning Pink Calcium Silicate block insulation, rigid hydrous asbestos-free operating temperature of 1200°F, meeting the requirements of ASTM C533 shall be used for flat surfaces. Owens-Corning Pink Calcium Silicate V-grooved block shall be used on curved surfaces, and shall be such that the V-grooves close tightly over the curved surfaces.
3. If required, boards shall be scored to allow them to conform to curved or irregular surfaces.

4. Mechanical fasteners shall be utilized to hold insulation to surface with bands as required to hold the curvature of the material.
5. Support rings shall be provided to support the top head insulation where required.
6. Outdoor installations require a weather barrier for protection of the insulation jacketing.

## 2.2 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
  1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure sensitive tapes.
  2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiberglass cloth, insulating cement; PVC fitting covers.
  3. Support Materials - Hanger straps, hanger rods, saddles.
  4. Fasteners, weld pins/studs, speed clips, insulation washers.
  5. Metal mesh or expanded metal lagging.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards".

## PART 3 EXECUTION

### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.2 PREPARATION

- A. Ensure that all tank, vessel, and equipment surfaces over which insulation is to be installed are clean and dry.

- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of tanks, vessels, and equipment has been completed prior to installing insulation.

### 3.3 INSTALLATION

#### A. General

- 1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- 2. Install insulation on tanks, vessels, and equipment subsequent to installation of heat tracing, painting, testing, and acceptance tests.
- 3. Install insulation materials with smooth and even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply using staggered joint method for both single and double layer installation, applying each layer of insulation separately.
- 4. Coat insulated surfaces where specified on contract drawings with layer of insulating cement, troweled in a workmanlike manner, leaving a smooth and continuous surface. Fill in seams, broken edges, and depressions. Cover over wire mesh and joints with cement sufficiently thick to remove surface irregularities.
- 5. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage.
- 6. Where specification calls for field-applied all-service vapor barrier jacketing, it shall be neatly fitted and tightly secured. Lap seams 2" (min.). Seal all joints with adhesive. Tape with 3" matching pressure-sensitive tape or 3" glass fabric and mastic.

#### B. Removable insulation

- 1. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance, such as vessel covers, fasteners, flanges, frames and accessories.

#### C. Areas left uninsulated

- 1. Items such as boiler manholes, handholes, clean-outs, ASME stamp, and manufacturers' nameplates, may be left uninsulated unless omitting insulation would cause a condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.

#### D. Equipment exposed to weather

1. Protect outdoor insulation from weather by installation of weather barrier mastic protective finish or jacketing as recommended by the jacketing manufacturer.

### 3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

### 3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

### 3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

### 3.7 ASBESTOS INSULATION

- A. Any existing asbestos insulation on existing ductwork, equipment, etc. where tie-ins are required, shall be removed by the Owner at the Owner's expense. The Contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

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SECTION 23 07 19

HVAC PIPE SYSTEM INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES PIPE INSULATION FOR:

- A. Heating hot water supply and return piping system.
- B. Refrigerant piping system.
- C. Cooling coil drain piping inside the building.
- D. Outdoor piping.
- E. Valves and fittings.
- F. Miscellaneous tanks, valves.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification, including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself, but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of the following specifications as applicable to the specific product or end use:
- B. American Society for Testing of Materials Specifications:
  - 1. ASTM C547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation"
  - 2. ASTM C533, "Standard Specification for Calcium Silicate Pipe & Block Insulation"
  - 3. ASTM C585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
  - 4. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only)
- C. Insulation materials, including all water and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.4 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following commercial piping systems, in



accordance with the applicable project specifications and drawings, subject to the terms and conditions of the contract:

1. Hot Piping – Fluid temperature 105°F and up.
2. Cold Piping – Fluid temperature below 105°F.

- B. Insulation, vapor barriers, jacketing, hangers, supports, accessory materials, etc. shall be installed according to manufacturer's recommendations.

## 1.5 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.

## 1.6 SYSTEM PERFORMANCE

- A. Insulation material furnished and installed hereunder shall meet the minimum thickness requirements of Standard 90.1 (2007), "Energy Efficient Design of new Buildings" of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) except minimum thickness shall be 1". However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

- B. Insulation materials furnished and installed hereunder shall be Class A maximum of 25 flame spread, 35 fuel contributed and 50 smoke developed rating and shall meet the fire hazard requirements of each of the following specifications:

1. American Society for Testing of Materials      ASTM E84
2. Underwriters' Laboratories, Inc.                      UL 723
3. National Fire Protection Associations              NFPA 255

- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

## 1.7 QUALITY ASSURANCE

- A. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

## PART 2 PRODUCTS

### 2.1 PIPE INSULATION ON INDOOR SYSTEMS

- A. Molded pipe insulation shall be manufactured to meet ASTM C585 for sizes required in the particular system.
  - B. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C547. Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure\* two-component adhesive closure system, or Fiberglas Pipe and Tank Insulation, heavy density fiberglass insulation with end grain adhered to ASJ all service jacket. Joints shall be sealed by butt strips having a two-component sealing system or by applying staples and pressure sensitive tape. When self-sealing lap systems are used, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150°F. Manufacturer's data regarding thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layer(s) shall be unjacketed.
  - C. Fittings and valves shall be insulated with preformed fiberglass fittings, fabricated sections of fiberglass pipe insulation, fiberglass pipe and tank insulation, fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall match that used on straight sections.
  - D. Flanges, couplings, valve bonnets etc, shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with sections of insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable vapor resistant mastic.
  - E. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
  - F. All insulated, exposed piping inside the building within 8'-0" above the floor shall be additionally jacketed with a multi-ply, fabric reinforced, self adhesive insulation cladding material with a vapor barrier and a thickness of 0.015". Jacketing system shall be Venture Clad Plus #1579CW-E or equal.
- 2.2 REFRIGERANT PIPING AND COOLING COIL DRAIN WITH INSTALLATION TEMPERATURE ABOVE 40°F
- A. Insulate piping with ¾" closed-cell, fiber-free elastomeric foam equal to Armaflex type AP insulation. Insulation shall be flexible elastomeric thermal insulation, black in color, flame-spread rating of 25 or less and a smoke developed rating of 50 or less as tested by ASTM E84-91A "Method of Test Surface Burning Characteristics of Building Materials".
  - B. Fitting elbow covers shall be fabricated from miter-cut tabular form. In all cases, butt joints and seams are to be sealed with Armstrong 520 adhesive. 520 adhesive is a contact adhesive; therefore, in all cases, both surfaces to be joined are to be coated with adhesive with installation temperature above 40°F.
  - C. Where piping is located outdoors, cover Armaflex insulation with PVC jacketing installed with a glued application.
- 2.3 SUPPORT FOR PIPE WITH INSULATION

- A. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that butt joints may be made outside the hanger.
1. On all size piping of cold systems, the pipe hanger saddles shall be separated away from the pipe by utilizing inserts. The vapor barrier shall be continuous, including material covered by the hanger saddle. Utilize a clevis style hanger with protective shield per MSS SP-69.
  2. On warm water piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation.
  3. For hot or cold piping systems larger than 2½" in diameter, Owens-Corning Calcium Silicate pipe insulation shall be used for high density inserts. Piping saddles for piping larger than 3" shall not be in contact with the piping. Vapor barrier shall cover inserts.
  4. Owens-Corning Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi.
  5. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
  6. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of the insulation are being used.
  7. On vertical runs, insulation support rings shall be used.

## 2.4 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
  2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiberglass cloth, insulating cement; PVC fitting covers.
  3. Support materials - Hanger straps, hanger rods, saddles.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards".

## 2.5 INSULATION THICKNESSES

- A. Fittings, including valves, flanges, unions, etc. shall be insulated with the same thickness as the required pipe insulation and covered with PVC fitting cover as specified.
- B. Pipe insulation thickness shall be as follows unless noted otherwise on drawings:

| <u>Piping System</u>   | <u>Pipe Size</u> | <u>Insulation Thickness</u> | Insulation<br>Conductivity<br>BTU in<br>H-Ft <sup>2</sup> -F |
|--|------------------|-----------------------------|--|
| Heating hot water and air<br>separator tank<br>(200°F and below) | Up thru 1¼"      | 1½"                         | 0.29   |
|  | 1½" and larger   | 2"                          |  |
| Refrigerant piping<br>(Armaflex insulation)                      | up to 1¼"        | ¾"                          | 0.28   |
|  | 1 ½" and larger  | 1"                          |  |

Note: piping located outdoors shall have the same insulation thickness as noted above.

## PART 3 EXECUTION

### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project may comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. All damaged insulation installed will be removed and replaced by the Contractor at no extra cost to the Owner.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

### 3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
2. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit overall piping surfaces.
4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

B. Fittings

1. Cover valves, fittings, and similar items in each piping system using one of the following:
  - a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
  - b. Insulation cement equal in thickness to the adjoining insulation.
  - c. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

C. Penetrations

1. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.

D. Joints

1. Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band.
2. All pipe insulation ends shall be tapered and sealed, regardless of service.

3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

### 3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

### 3.7 ASBESTOS INSULATION

- A. Any existing asbestos insulation on existing piping, valves, equipment, etc. where tie-ins are required, shall be removed by the Owner at Owner's expense. The contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

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SECTION 23 09 00  
TEMPERATURE CONTROL SYSTEM

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Products Furnished, But Not Installed Under This Section
- B. Related Sections
- C. Description
- D. Approved Control System Contractor
- E. Quality Assurance
- F. Codes and Standards
- G. System Performance
- H. Submittals
- I. Warranty
- J. Ownership of Proprietary Material

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Hydronic Piping:
  - 1. Control Valves
  - 2. Temperature Sensor Wells and Sockets
  - 3. Flow Meters
- B. Ductwork Accessories:
  - 1. Automatic Dampers
  - 2. Airflow Stations

1.3 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.
- B. The following sections constitute related work:
  - 1. Basic Mechanical Requirements
  - 2. Air Distribution Materials and Methods

3. Valves, Fittings, and Piping Accessories
4. Refrigeration Equipment
5. Air Handling Equipment
6. Air Distribution
7. Test and Balance
8. Basic Electrical Requirements
9. Basic Electrical Materials
10. General Wiring
11. Equipment and Motor Wiring
12. Uninterruptible Power Supply
13. Emergency Systems

#### 1.4 DESCRIPTION

- A. General: The control system shall be as indicated on the drawings and described in the specifications, and consist of a peer-to-peer network of digital building control panels and operator workstation(s). The user interface shall through any personal computer available on the network. The PC shall provide users an interface with the system though dynamic color graphics of building areas and systems.
- B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator ID and password. An operator shall be able to log onto any PC on the designated network and have access to all designated data.
- D. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
- E. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A modem or internet connectivity may be provided for remote access to the system.

#### 1.5 BASIC SCOPE OF WORK

- A. The following Scope notes the basic temperature control system items, but is not all inclusive. See drawings for further information. All new temperature control devices shall be direct digital controlled.
- B. The Temperature Control Contractor shall provide associated software, color graphics, etc. to control and monitor new and existing equipment.
- C. The Temperature Control contractor shall coordinate with Air Balance Contractor to calibrate all new volume boxes and airflow stations.

#### 1.6 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

- A. Approved Control System Contractors and Manufacturers:



| Manufacturer Name | Product Line | Contractor Name/Address | Contact |
|-------------------|--------------|-------------------------|---------|
| Trane             | Tracer SC    | Trane                   |         |

1. The above list of manufacturers applies to user interface, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

#### 1.7 QUALITY ASSURANCE

##### A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office within [50] miles of the project site and provide [24-hour] response in the event of a customer call.

#### 1.8 CODES AND STANDARDS

##### A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Mechanical Code (IMC)
4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.

#### 1.9 SYSTEM PERFORMANCE

##### A. Performance Standards. The system shall conform to the following:

1. Page Display. The system shall display a web page will be displayed within [5] seconds of the request. There is no maximum amount of dynamic points that can be displayed.- Paul to confirm
2. Page Refresh. The system shall update all within [10] seconds.
3. Graphic Refresh. The system shall update all dynamic points with current data within [30] seconds.
4. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be [10] seconds. Analog objects shall start to adjust within [10] seconds.-
5. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior [60] seconds.

6. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed [30] seconds.
7. Program Execution Frequency. Custom programs shall be capable of running as often as once every second. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
8. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every [5] seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
9. Multiple Alarm Annunciation. All users on the network shall receive alarms within [10] seconds of each other.
10. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

**Table 1**  
**Reporting Accuracy**

| Measured Variable                 | Reported Accuracy   |
|-----------------------------------|---|
| Space Temperature                 | $\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]     |
| Ducted Air                        | $\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]     |
| Outside Air                       | $\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]     |
| Water Temperature                 | $\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]     |
| Delta-T                           | $\pm 0.15^{\circ}\text{C}$ [ $\pm 0.25^{\circ}\text{F}$ ] |
| Relative Humidity                 | $\pm 5\%$ RH  |
| Water Flow                        | $\pm 5\%$ of full scale                                   |
| Air Flow (terminal)               | $\pm 10\%$ of reading *Note 1                             |
| Air Flow (measuring stations)     | $\pm 5\%$ of reading                                      |
| Air Pressure (ducts)              | $\pm 25$ Pa [ $\pm 0.1$ "W.G.]                            |
| Air Pressure (space)              | $\pm 3$ Pa [ $\pm 0.01$ "W.G.]                            |
| Water Pressure                    | $\pm 2\%$ of full scale *Note 2                           |
| Electrical Power                  | $\pm 5\%$ of reading *Note 3                              |
| Carbon Monoxide (CO)              | $\pm 5\%$ of reading                                      |
| Carbon Dioxide (CO <sub>2</sub> ) | $\pm 50$ PPM  |

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: \* not including utility supplied meters

#### 1.10 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. [Six (6)] copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.
- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.

- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within [60] days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
  2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
  3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
  4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
    - a) Building Controllers
    - b) Custom Application Controllers
    - c) Application Specific Controllers
    - d) Operator Interface Computer(s)
    - e) Portable Operator Workstation
    - f) Auxiliary Control Devices
    - g) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
    - h) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
    - i) Points list showing all system objects, and the proposed English language object names
    - j) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
    - k) Color prints of proposed graphics with a list of points for display
- E. Project Record Documents. Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
  2. Testing and Commissioning Reports and Checklists.
  3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
    - a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
    - b) Provide on-line help for documenting operator instructions

- c) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
  - d) One set of electronic media containing files of all color-graphic screens created for the project.
  - e) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
  - f) Licenses and warranty documents for all equipment and systems.
  - g) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.
- F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

#### 1.11 WARRANTY

A. Warrant all work as follows:

- 1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
- 2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
- 3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.
- 4. The system provider shall provide a web-accessible system and support on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

#### 1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:
- 1. Project graphic images
  - 2. Record drawings
  - 3. Project database
  - 4. Project-specific application programming code
  - 5. All documentation

#### PART 2: PRODUCTS

2.1 SECTION INCLUDES

- A. Materials
- B. Communication
- C. Operator Interface
- D. Application and Control Software
- E. Building Controllers
- F. Custom Application Controllers
- G. Application Specific Controllers
- H. Input/Output Interface
- I. Auxiliary Control Devices
- J. Variable frequency drives

2.2 MATERIALS

- A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract.

2.3 COMMUNICATION

- A. This project shall comprise of a network utilizing high-speed [BACnet] for communications between Building Controllers. LonTalk or BACnet MSTP sub-networks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.
- B. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the internetwork. An active Ethernet jack will be provided adjacent to each Building Control Panel and PC Workstation for connection to this network.

All Building Controllers shall have a Ethernet communications port for connections with the operator interfaces.

- C. Remote operator interface via a 56K baud modem shall allow for communication with any and all controllers on this network as described in the following paragraph.
- D. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:

1. Connection of an operator interface device to any one building controller on the internetwork will allow the operator to interface with all other building controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all building controllers shall be available for viewing and editing from any one building controller on the internetwork.
  2. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- E. The time clocks in all building controllers shall be automatically synchronized daily.
- 2.4 OPERATOR INTERFACE
- A. Operator Interface. Furnish [1] PC based workstation as shown on the system drawings. Each workstation shall be able to access all information in the system. Workstations shall reside on the same high-speed network as the building controllers, and also be able to dial into the system.
- B. Workstation information shall be provided through web pages.
- C. User Interface
1. Internet Browser. Furnish with either Internet Explorer 7.0 or higher, or Firefox 3.0 or higher. Java 5.0 or higher must also be installed on the PC.
  2. User interface. The system user interface shall be web based graphically orientated. Provide a method for the operator to easily move between web pages. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
  3. Custom background images. Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as BMP, GIF and JPEG.
  4. Graphics Library. Furnish a library of standard HVAC equipment including, air handling units, and VAV boxes, in 3-dimensional graphic depictions.. The library shall be furnished in a file format compatible with the graphics generation package program.
  5. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Inch /Pound.
- D. System Applications. Each building controller shall provide storage of system information. Provide the following applications at each building controller.

1. Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
2. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.
3. On-Line Help and Training. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all system functions and shall provide the relevant data for that particular screen. Additional help shall be available through the use of hypertext links onscreen.
4. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. All system security data shall be stored in an encrypted format.
5. System Diagnostics. The system shall automatically monitor the operation of all, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
6. Alarm Notification. Operator shall be notified of new alarm as they occur while navigating through any part of the system with a alarm icon. Alarm messages shall use full language, easily recognized descriptors for alarm. System will have the capability to acknowledge Alarms and add and save comments for the alarm.
7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
8. Alarm Reactions. A user shall be able to determine what actions will occur if any, upon receipt of an alarm. Actions shall display on the screen, logging, start a custom control program, displaying messages, send a SMTP e-mail message that can be directly displayed on a smart phone, or forwarded to a cell phone via a text message. . Each of these actions shall be configurable by any PC and time of day. .
9. Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in up to 4 categories based on severity. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be stored by the building controller. Provide a comment field in the event log that allows a user to add specific comments associated with any alarm.
10. Trend Logs. The system shall automatically create trend logs for a minimum of 5 key measurements for each controlled HVAC device. The automatic trend logs shall monitor these parameters for a minimum of 24 hours at 15 minute intervals. The automatic trend logs shall be user adjustable. A user shall also be able to define a trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals shall be as frequently as 1minute up to yearly sampling and shall be selectable. Trend data shall be sampled and stored on the Building Controller panel and can be archived on a PC. Trend data shall be able to be viewed and printed from the operator interface software. Trends must be

viewable in a text-based format or graphically. Trends shall also be storable in a CSV or PDF format for use by other industry standard word processing and spreadsheet packages.

11. Dynamic Graphical Trending. The system shall have the ability to save the data collected by a trend object and display that collected data in a graphical chart. Trend viewing capabilities shall include the ability to show up to 6 points on a chart, to include live and/or historical data. Each data point trend line shall be an individual color. Navigation and viewing functions shall include scrolling and zooming of x and y axes, and a trace display of the associated time stamp, and values for any selected point along the x-axis.
  13. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics or through custom programs.
  14. Clock Synchronization. A designated building controller shall synchronize all other building controllers on the network. A building controller shall also be able to synchronize with a NTP server for automatic time synchronization. The system shall automatically adjust for daylight savings time if applicable.
  15. Reports and Logs. Provide a reporting package that allows the operator to select reports. A number of different reports shall be available to be selected by the user and provide current data. All reports can be set up to be run at specified intervals of time. Reports and logs shall be stored on the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals. Provide a means to list and access the last 10 reports viewed by the user.
    - i. All Points in Alarm Report: Provide an on demand report showing all current alarms.
    - ii. All Points in Override Report: Provide an on demand report showing all overrides in effect.
    - iii. Commissioning Report: Provide a one time report that lists all equipment with the unit configuration and present operation.
    - iv. Points report: Provide a report that lists the current value of all points
- E. Workstation Applications Editors. Each PC workstation shall support dedicated screens for editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.
1. Controller. Provide a full screen editor for each type custom application, and application specific controller that shall allow the operator to view and change the configuration, name, control parameters, and system set-points.
  2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. An advance and delay time for each object shall be adjustable from this master schedule. An operator shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.



3. Manual Control and Override. Provide a means of manually controlling analog and binary output points. Control overrides shall be performed through a simple. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
4. Air System Equipment Coordination. Provide editor screens with monitoring and control functions that group together and coordinates the operation of air handling equipment and associated VAV boxes as specified in the sequence of operations. For each air system, the editor pages shall include:
  - a) System mode of the air handling system
  - b) Listing and assignment of the associated air handler and VAV boxes
  - c) RTU supply air cooling and heating set points
  - d) RTU minimum, maximum and nominal static pressure set points
  - e) VAV box minimum and maximum flow, and drive open and close overrides

## 2.5 APPLICATION AND CONTROL SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.
- B. System Security
  1. User access shall be secured using individual security passwords and user names.
  2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator
  3. User logon/logoff attempts shall be recorded.
  4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
  1. Weekly Schedule. Provide separate schedules for each day of the week.
  2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
  3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
  4. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater

than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

- D. Remote Communications. The system shall have the ability to transmit alarms to multiple associated alarm receivers. Receivers shall include PC Workstations, email addresses, and cell phones. The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system utilizing the system Ethernet communications, or dial up communications via modem, in the same format and method used on site as described under the Operator Interface section of this specification.
- E. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, and set-point, shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- F. Point control. User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events
- G. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.
- H. Anti-Short Cycling. All binary output points shall be protected from short cycling.

## 2.6 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
  - 1. The Building Automation System shall be composed of one or more independent, standalone, microprocessor based Building Controllers to manage the global strategies described in System software section.
  - 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  - 3. The controller shall provide a USB communications port for connection to a PC
  - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  - 5. Controllers that perform scheduling shall have a real time clock.
  - 6. Data shall be shared between networked Building Controllers.
  - 7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
  - 8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a) Assume a predetermined failure mode.
    - b) Generate an alarm notification.
    - c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.

- d) Automatically reset the Building Controller to return to a normal operating mode.
- B. Communications. Each Building Controller shall reside on a BACnet internetwork using the IEEE 802.3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.] [Optional – Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles and/or use BACnet MSTP as prescribed by the BACnet standard to perform communications to a network of Custom Application and Application Specific Controllers.]
- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 C to 50 C [-40 F to 122 F].
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal connectors. The building controller shall utilize standard DIN mounting methods for installation and replacement.
- E. Memory. The Building Controller shall maintain all BIOS and programming information indefinitely without power to the building controller.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

## 2.7 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
  - 1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  - 2. Controllers that perform scheduling shall have a real time clock.
  - 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  - 4. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.
    - a. Custom application controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall be with the use of LonMark-approved SNVTs.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
  - 1. Controller used in conditioned ambient shall be mounted in IP 20 type enclosures, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
  - 2. Controllers used outdoors and/or in wet ambient shall be mounted within IP 56 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C [-40 F to 158 F].

- C. A local operator interface shall be provided at building locations where specified in the sequence of operations or point list. The operator interface shall be provided for interrogating and editing data. A system security password shall be available to prevent unauthorized use of the keypad and display.
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.
- E. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

## 2.8 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
  - 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
  - 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
  - 1. Controller used in conditioned ambient spaces shall be mounted in IP 20 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C [32 F to 120 F].
  - 2. Controllers used outdoors and/or in wet ambient shall be mounted within IP 56 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C [-40 F to 150 F].
- C. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

- G. Application Specific Controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall follow LonMark profiles. ASCs which do not have a profile that applies must comply with LonMark standards, utilize SNVTs for all listed points, and be provided with a XIF file for self-documentation.

## 2.9 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs on custom application controllers shall have 3-mode (on/off/auto) program override control from the panel with output status lights.]
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. [Optional: Analog outputs on custom application controllers shall have a 2-mode (auto/manual) program override control, with manual output adjustment over 0-100% of range.]

## 2.10 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
  - 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
  - 2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
  - 3. Damper shaft bearings shall be as recommended by manufacturer for application.
  - 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
  - 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.

6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electric damper/valve actuators.
1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
  2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
  3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
  4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
  5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
  6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
  7. Actuators shall be Underwriters Laboratories Standard 873 listed.
  8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- D. Control Valves
1. Modulating 3 Way Applications (½" to 3") shall be an actuated ball valve. Acceptable Manufacturer – Griswold Controls, Johnson Controls, Belimo, Neptonic, or approved equal. (Note: The mechanical trades shall furnish a Griswold auto balance valve for each piece of equipment where 3-way valves are noted).
    - a. Valve housing shall consist of forged brass CuZn39Pb2 rated at no less than 360 psi at 250°F.
    - b. Valve ball shall consist of chemically nickel-plated brass. 2-Way Valve: Manufacturer shall be able to provide optional 316 SS ball and stem.
    - c. Valve shall have a blow-out proof stem with two EPDM O-Rings with minimum 600 psi rating.
    - d. Manufacturer shall be able to provide glass-filled polymer ball insert to make flow control equal percentage.
    - e. Valve shall have EPDM O-Rings behind ball seals to allow for a minimum close-off pressure of 40 psi with 35 in-lbs of torque for 1/2" - 2" sizes.
    - f. Valve shall be available with a minimum of 25 unique Cv values and bypass Cv shall be 80% of Through Cv.
    - g. Valve shall be available with fixed end female, fixed end sweat or union end connections.
    - h. Valves shall be installed in Tee configuration with actuator perpendicular to shaft. Valve shall not require elbows of any kind.

- i. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, ELO Drive, Honeywell, Invensys, Johnson Controls, KMC, Neptronic, or Siemens. The control valve actuator may be furnished by the controls contractor under Section 15970 or by the Valve manufacturer.
    - j. Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number and location; tags shall be 3" x 3" aluminum.
  2. Modulating 3 Way Applications (4" to 6") shall be an actuated ball valve.  
Acceptable Manufacturer – Griswold Controls, Johnson Controls, Belimo, Neptronic, or approved equal. (Note: The mechanical trades shall furnish a Griswold auto balance valve for each piece of equipment where 3-way valves are noted).
    - a. Valve housing shall consist of cast iron ASTM A395, 60-40-18 rated at no less than 240 psi at 250°F. Valve housing shall have ANSI Class 125 flanges.
    - b. Valve ball shall consist of stainless steel with parabolic ports to make flow control equal percentage.
    - c. Valve shall have a blow-out proof stem with two EPDM O-Rings.
    - d. Valve shall have EPDM O-Rings behind ball seals to allow for a minimum close-off pressure of 70 psi with 88 in-lbs of torque for 4" and 5" valves. 6" valves shall require actuators with 140 in-lbs of torque for flowrates under 700 gpm.
    - e. Valve shall be available with a minimum of 5 unique Cv values for each size, and the Bypass Cv shall be 80% of Through Cv.
    - f. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, ELO Drive, Honeywell, Invensys, Johnson Controls, KMC, Neptronic, or Siemens. The control valve actuator may be furnished by the controls contractor under Section 15970 or by the Valve manufacturer.
    - g. Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number and location; tags shall be 3" x 3" aluminum
3. Two Way Applications (1/2" – 2")  
Acceptable Manufacturer – Griswold Controls, Johnson Controls, Belimo, Neptronic, Tour & Andersson by Victaulic or approved equal.
  - a. All two way temperature control valves shall be pressure independent actuated ball valves and cartridge. (Pressure Independent Balancing Control Valves) unless specifically noted on the drawings to be standard two way control valves.
    1. The modulating control valves shall be pressure independent and shall include a Pressure Compensating Cartridge or Differential Pressure Controller, Actuated Ball Valve or Shaped plug for proportional water balance control, and Manual Isolation Ball in a single valve housing or tight shut off with separate seat.
    2. Valve shall have an optimization insert to provide a linear output of connected heat transfer device, or not require separate insert but adjustable in the field.
    3. Valve housing shall consist of forged brass, rated at no less than 360 or 230 psi at 250°F.

4. Valve shall have a fixed end or union end connection with factory installed air vent to allow for venting of the coil or heat pump.
  5. Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and flow limiting ball/shaped plug shall be standard.
  6. A flow tag shall be furnished with each valve.
- b. Pressure compensating cartridge (pcc)
1. PCC shall automatically compensate for pressure changes in valve and shall maintain a constant pressure drop across the flow limiting actuated ball and provide maximum design water flow meter required for system water balance.
  2. The operating pressure range shall be available with the minimum range requiring 2.2 PSID to actuate the mechanism.
  3. Valve internal control mechanism includes a diaphragm and full travel linear coil spring.
  4. Valves shall include a field accessible/ replaceable cartridge or adjustable for various flows without removing any items.
  5. Valve is to be flushable to remove any debris that may be in system during start-up.
- c. Actuated flow limiting ball valve
1. Valve ball shall consist of chemically plated nickel brass or stainless steel or shaped plug made of PPS (polyphenylsulphide).
  2. Actuated stem shall be removable/replaceable without removing valve from line.
  3. Manufacturer shall be able to provide ball insert to limit flow to maximum flow rate with  $\pm 5\%$  accuracy. Shaped plug shall be infinitely adjustable in field.
  4. Valve shall have EPDM O-rings behind the seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2" - 3" sizes.
  5. The actuator and plate can be rotated after mounting.
  6. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, ELO Drive, Honeywell, Invensys, Johnson Controls, KMC, Neptronic, or Siemens. The control valve actuator may be furnished by the controls contractor under Section 15970 or by the Pressure Independent Control Valve manufacturer.
- d. Isolation ball valve
1. Valve shall include a 600 WOG manual isolation ball valve
4. Two Way Applications (2-1/2" - 6")
- Acceptable Manufacturer - Griswold Controls, Johnson Controls, Belimo, Neptronic, or approved equal.



- a. All two way temperature control valves shall be pressure independent dynamic flow control valve type unless specifically noted on the drawings to be standard two way control valves.
  1. Dynamic control valve shall accurately control flow, independent of system pressure fluctuation to allow system water balance.
  2. Contactor shall install dynamic flow control valves where indicated in drawings.
  3. Valve shall be electronic, dynamic, modulating 2-way control device
  4. Maximum flow setting shall be adjustable to 51 different settings within the range of the valve size by changing the actuator dip switches.
  5. Balancing valves shall not be required where pressure-independent valves are installed.
- b. Valve housing
  1. 2"-6": Housing shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 580 psi static pressure and 248°C.
- c. Flow regulation unit
  1. Flow regulation unit shall consist 316 Stainless Steel and EPDM.
  2. Flow regulation unit shall be field accessible for maintenance.
  3. Dual pressure/temperature test valves for verifying accuracy of flow performance shall be available for all valve sizes

E. Binary Temperature Devices

1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed set point adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented cover.
2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed set point adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented cover.
3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].

6. The space temperature, set point, and override confirmation will be annunciated by a digital display for each zone sensor. The set point will be selectable utilizing buttons.
7. Individual set point adjustment at the space temperature sensor shall be limited to +/- 3 degrees from BAS set point.

G. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of  $\pm 5\%$  R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 C to 75 C [-40 F to 170 F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

H. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

I. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

J. Carbon Dioxide (CO<sub>2</sub>) Sensors

1. Carbon Dioxide sensors shall measure CO<sub>2</sub> in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated on the drawings.
2. Refer to drawings for CO<sub>2</sub> calibration set points.
3. Space mounted sensors shall be installed between 3 feet and 6 feet above finished floor.

K. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.

2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with IP 20 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), IP 20 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

L. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide IP 20 Type enclosure when not installed in local control panel.

M. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 70.0 mV maximum Peak-to-Peak. Regulation shall be 5% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

N. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

O. LOCAL CONTROL PANELS

1. All indoor control cabinets shall be fully enclosed IP 20 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection for control power sources to each local panel.

2.11 VARIABLE FREQUENCY DRIVES

- A. Subject to compliance with these specifications, the following VFD manufacturers shall be acceptable:
1. AC Tech
  2. ABB
  3. Yaskawa
  4. Danfoss
- B. Variable Frequency Drive (VFD)
1. The variable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design. VFD shall be capable of operating in voltage ranges of 200 to 240V and 380 to 480V AC, +/- 10%, three phase; at frequencies of 48 to 63 Hz.
  2. The VFD, including all factory-installed options, shall have UL and cUL approval.
  3. Enclosure shall be NEMA 1 ventilated for installation as a wall mounted or freestanding unit, depending on the amp rating. Drive shall be equipped with an input disconnect switch, padlockable in the open position for safety during maintenance, and fuses to protect against ground faults. A hand-off-auto switch and speed potentiometer shall be functional via VFD keypad.
  4. VFD shall utilize a full wave rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.98 regardless of speed or load. VFDs employing power factor correction capacitors shall not be acceptable.
  5. Insulated gate bipolar transistors shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency, AC output.
  6. The output switching frequency shall be selectable at 4 or 8 kHz. VFDs with an operable carrier frequency above 10 kHz shall not be acceptable.
  7. An internal line reactor shall be provided to lower harmonic distortion of the power line and to increase the fundamental power factor.
  8. The VFD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 degrees F. VFD shall be suitable for operation in environments up to 95% non-condensing humidity.
  9. The VFD shall be capable of displaying the following information in plain English via a 40 character alphanumeric display:
    - a. Output Frequency
    - b. Output Voltage
    - c. Motor Current
    - d. Kilowatts per hour
    - e. Fault identification with text
    - f. Percent torque
    - g. Percent power
    - h. RPM

10. All VFDs shall be warranted for a period of 30 months from date of shipment or 24 months from date of start-up, whichever comes first. This warranty shall cover parts, labor, travel time, and expenses.
11. The Temperature Controls Contractor shall furnish and install all programming devices, sensors, transmitters, and other control components, as required to perform the pump operations described in the sequence of operations.

### PART 3 EXECUTION

#### 3.1 SECTION INCLUDES:

- A. Examination
- B. Protection
- C. General Workmanship
- D. Field Quality Control
- E. Wiring
- F. Fiber Optic Cable
- G. Installation of Sensors
- H. Flow Switch Installation
- I. Actuators
- J. Warning Labels
- K. Identification of Hardware and Wiring
- L. Controllers
- M. Programming
- N. Cleaning
- O. Training
- P. Acceptance

#### 3.2 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

### 3.3 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

### 3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

### 3.5 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

### 3.6 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Division 16 of these specifications. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
- C. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- D. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- F. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- H. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- I. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- L. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- M. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- N. Adhere to Division 16 requirements for installation of raceway.
- O. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- P. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade

size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

### 3.7 FIBER OPTIC CABLE SYSTEM

- A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacture's specifications.
- C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

### 3.8 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.
- J. Space mounted CO<sub>2</sub> sensors shall be installed between 3 feet and 6 feet above finished floor.

### 3.9 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Install and adjust flow switch in accordance with manufacturers' instructions.



- C. Assure correct flow direction and alignment.
- D. Mount in horizontal piping - flow switch on top of the pipe.

### 3.10 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
  - 1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
  - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
  - 3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

### 3.11 WARNING LABELS

- A. Affix labels on each starter and equipment automatically controlled through the DDC System. Warning label shall indicate the following:

**CAUTION**

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Affix labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Labels shall indicate the following:

**CAUTION**

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

### 3.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1-cm (1/2") letters on nameplates.

- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

### 3.13 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
  - 1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

### 3.14 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
  - 1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
  - 1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Air Handler, VAV Terminal, Fan Coil and Boiler. These standard graphics shall show all points dynamically as specified in the points list.
  - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of [16] hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

- E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

### 3.15 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

### 3.16 TRAINING

- A. Provide a minimum of [4] classroom training sessions, [4] hours each, throughout the contract period for personnel designated by the Owner. Computer-based audio-visual training may be substituted for up to [8] hours of hands on training.
- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.
- C. Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:
  1. Day-to-day Operators
  2. Advanced Operators
  3. System Managers/Administrators
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.

- G. This training shall be made available in addition to the interactive audio-visual tutorial, provided with the system.

### 3.17 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

### 3.18 INSTRUCTIONS TO OTHER CONTRACTORS

#### A. Control Valve Installation

1. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
2. All control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.
3. Valves shall be installed in accordance with the manufacturer's recommendations.
4. Control valves shall be installed so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
5. Isolation valves shall be installed such that control valve body may be serviced without draining the supply/return side piping system. {Note to designer: this must also be shown.} Unions shall be installed at all connections to screwed type control valves.
6. Provide tags for all control valves indicating service and number. Tags shall be brass, 1-1/2" in diameter, with 1/4" high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

#### B. Control Damper Installation

1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.
3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal  $\pm 1/8"$ .

4. Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
6. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
7. Provide a visible and accessible indication of damper position on the drive shaft end.
8. Support duct-work in area of damper when required to prevent sagging due to damper weight.
9. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

C. Duct Smoke Detection

1. Provide complete submittal data to controls system contractor for coordination of duct smoke detector interface to HVAC systems.
2. This contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.19 COMMISSIONING REPORTS

- A. The following commissioning reports are to be filled out by the temperature control contractor for each piece of HVAC equipment:

| Rooftop Unit Standard Report     |               |
|----------------------------------|---------------|
|                                  | Current Value |
| Rooftop Unit Tagging             |               |
| Model Number                     |               |
| Serial Number                    |               |
| Communicating State              |               |
| Unit Size - tons                 |               |
| heat/Cool Mode                   |               |
| Space Temperature - deg F        |               |
| Cooling Setpoint - deg F         |               |
| Heating Setpoint - deg F         |               |
| Supply Air Temperature - deg F   |               |
| Compressor Status                |               |
| Compressor A                     |               |
| Compressor B                     |               |
| Compressor C                     |               |
| Compressor D                     |               |
| Units with Economizers:          |               |
| OK to Economize?                 |               |
| Econ Damper Position - %         |               |
| Econ Minimum Position - %        |               |
| Outdoor Air Temp - deg F         |               |
| Exhaust Fan Status               |               |
| Exhaust Damper Position - %      |               |
| Optional Sensors:                |               |
| OA Humidity - % RH               |               |
| RA Temperature - deg F           |               |
| RA Humidity - % RH               |               |
| Optional Enthalpy Sensors:       |               |
| OA Enthalpy - BTU/LBM            |               |
| RA Enthalpy - BTU/LBM            |               |
| Heat Output 1 Status             |               |
| Heat Output 2 Status             |               |
| Heat Output 3 Status             |               |
| Supply Fan Status                |               |
| Supply Fan: IGV/VFD Position - % |               |
| Space Pressure - IWC             |               |
| Space Pressure Setpoint - IWC    |               |
| Units with TRAQ Damper Option    |               |
| Outdoor Air Flow - CFM           |               |
| Outdoor Air Flow Stpt - CFM      |               |

| VAV Box Standard Report                    |               |
|--|---------------|
|  | Current Value |
| VAV Tagging                                |               |
| Model Number                               |               |
| Serial Number                              |               |
| Communicating State                        |               |
| Unit Size (CFM)                            |               |
| Heat Exists                                |               |
| Fan Exists                                 |               |
| *Auxiliary Input Configuration             |               |
| *Binary Input Configuration                |               |
| Present Value                              |               |
| Zone Temperature (Deg F)                   |               |
| Active cooling Setpoint (Deg F)            |               |
| Active Heating Setpoint (Deg F)            |               |
| Occupied SetPoint Source                   |               |
| Occupied Cooling setpoint (Deg F)          |               |
| Occupied Heating Setpoint (Deg F)          |               |
| Thumbwheel Setpoint (Deg F)                |               |
| Unoccupied Cooling Setpoint (Deg F)        |               |
| Unoccupied Heating Setpoint (Deg F)        |               |
| Airflow (CFM)                              |               |
| Maximum Airflow Setpoint (CFM)             |               |
| Minimum Cooling Airflow Setpoint (CFM)     |               |
| Minimum Heating Airflow Setpoint (CFM)     |               |
| *Minimum Local Heat Airflow Setpoint (CFM) |               |
| *Use Minimum Local Heat Airflow Setpoint   |               |
| Occupied Outside Airflow Setpoint (CFM)    |               |
| Unoccupied Outside Airflow Setpoint (CFM)  |               |
| Non-Trane boxes - manual entries           |               |
| Airflow Correction Factor                  |               |
| Air Damper Drive Time (Sec)                |               |
| Water Valve Drive Time (Sec)               |               |
| Water Valve Configuration                  |               |

| Cabinet Heater Standard Report |                  |
|--------------------------------|------------------|
|                                | Current<br>Value |
| Cabinet Heater Tagging         |                  |
| Model Number                   |                  |
| Serial Number                  |                  |
| Communicating State            |                  |
| Heat Mode                      |                  |
| Space Temperature              |                  |
| Space Setpoint                 |                  |
| Supply Fan Status              |                  |
| Local Supply Fan Switch        |                  |
| Supply Fan Run Time            |                  |
| Heating Output                 |                  |
| Outdoor Air Temperature        |                  |
| Entering Water Temperature     |                  |
| Discharge Air Temperature      |                  |



23 09 00-35

SECTION 23 09 13.23

SENSORS AND TRANSMITTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resistance temperature detector (RTD) and transmitter.
- B. Pressure sensor and transmitter.
- C. Flow sensor and transmitter.
- D. Differential pressure sensor.

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 RESISTANCE TEMPERATURE DETECTOR (RTD) AND TRANSMITTER

- A. Furnish and install resistance temperature detector (RTD) and transmitters of quantity, size and at locations as indicated on drawings. The RTD sensing element shall be directly mounted to a transmitter for measuring a temperature and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.2\%$  of span or its span range. The span range shall be verified with the span of the operating temperature of the system.
- B. A 316 stainless steel element sheath, spring loaded into a 316 stainless steel well having a 3" lagging length and a  $\frac{3}{4}$ " NPT process connection. The unit shall have a watertight (NEMA Type 4) electrical enclosure with a  $\frac{1}{2}$ " NPT conduit connection.
- C. Sensors and transmitters shall be by ABB Kent Taylor, Bell and Gossett or approved equal.

2.2 PRESSURE SENSOR AND TRANSMITTER

- A. Furnish and install pressure gauge sensor and transmitter of quantity, size and at locations as indicated on drawings for measuring gauge pressure and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.5\%$  of full span and have an adjustable span limit and withstand over ranges up to a static pressure of 100 psi with negligible change in output. (Verify span of pressure capable of system shown on drawings to be monitored for selection of full span of sensor.)
- B. Pressure sensor shall have stainless steel wetted parts with  $\frac{1}{4}$ " NPT male process connection. Unit shall be protected against radio frequency interference and shall have a watertight (NEMA Type 4) electrical enclosure with a  $\frac{1}{2}$ " NPT conduit connection.

- C. Sensors and transmitters shall be by ABB Kent Taylor, Bell and Gossett, Kele or approved equal.

## 2.3 DIFFERENTIAL PRESSURE SENSOR

- A. Furnish and field mount differential pressure transmitters of quantity, size and location as indicated on plans for measuring differential pressure and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.25\%$  of full span limit (as required for system) and shall withstand over ranges up to a static pressure of 200 psi with negligible change in output.
- B. The units shall have a corrosion resistant stainless steel body with  $\frac{1}{4}$ " N.P.T. process connections. A 3 valve bypass manifold shall be included. Unit shall be protected against radio frequency interference and shall have a watertight (NEMA Type 4) electrical enclosure with  $\frac{1}{2}$ " N.P.T. conduit connection.
- C. Sensor and transmitters shall be by ABB Kent Taylor, Bell and Gossett or approved equal.

## 2.4 FLOW SENSOR AND TRANSMITTER

- A. Furnish and install flow sensors and transmitters of quantity, sizes and at locations as indicated on drawings.
- B. Flow sensor shall be magnetic flow type, transmitter integral with sensor, accuracy of  $\pm 0.2\%$  of reading, 4 to 20 mA dc output for use in a standard two-wire 24V dc system.
- C. Flow sensor and transmitter shall mount directly into pipe line at any attitude, but insuring that electrodes are not in vertical plane.
- D. Unit shall have 150 psi rated carbon steel flanges, end connection with polyurethane liner and stainless steel electrodes.
- E. Flow sensor and transmitter shall be ABB Kent Taylor Magmaster.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install sensors and transmitters in locations where they are easily serviced.
- D. Locate test plugs adjacent to sensors and transmitters.
- E. Furnish and install all piping, pipe wells, mounting hardware, etc. required for installation of sensors and transmitters.

END OF SECTION

MAI: 2022-1558

SECTION 23 21 00

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings.
- B. Valves.
- C. Heating hot water piping system.
- D. Equipment drains and overflows.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use.

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.5 - Refrigeration Piping.
- F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- G. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- H. ASTM A536 - Ductile Iron Castings.
- I. ASTM B32 - Solder Metal.
- J. ASTM B88 - Seamless Copper Water Tube.
- K. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- L. ASTM F1476 - Standard Specification for the Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- M. AWS A5.8 - Brazing Filler Metal.
- N. AWS D1.1 - Structural Welding Code.
- O. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

- P. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- Q. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- R. ANSI/AWWA C606 - Grooved and Shouldered Joints.

## PART 2 PRODUCTS

### 2.1 HEATING HOT WATER PIPING up to 230°F, ABOVE GRADE

- A. Heating hot water piping 3" and smaller shall be:
  - 1. Copper tubing: ASTM B88, Type L hard drawn.
    - a. Fittings: ASME B16.18 cast bronze, tee tap or ASME B16.22 solder wrought copper.
    - b. Joints: 95-5 tin-antimony or tin and silver with melting range 430 to 535 degrees F.
    - c. Heating hot water piping 2" thru 3" may be Victaulic 'CTS' grooved piping system using EPDM gasketing as an option to soldering.
      - 1) Roll grooved ends as appropriate to type L hard drawn tubing, pressures, size and method of joining, Tubing ends shall be grooved in accordance with manufacturer's current listed standards to copper tube dimensions. (Flaring of tubing ends to accommodate alternate sized couplings is not allowed.
      - 2) Victaulic Style 607H Installation-Ready couplings shall consist of ductile iron housings, conforming to ASTM A395 and A536, cast with offsetting, angle-pattern bolt pads, coated with grade EHP gasket suitable for water temperatures to +250 degrees F, copper colored alkyd enamel, complete with type synthetic rubber gasket.
        - a) Installation ready, for direct stab installation without field disassembly.
      - 3) Valves Victaulic Style 608 butterfly valve with grooved ends manufactured to copper tube dimensions.
      - 4) Victaulic 'CTS' Grooved End Fittings: ASME B16.18 bronze sand cast or ASME B16.22 wrought copper. Manufactured to copper tube dimensions. (Flaring of fitting end to IPS dimensions is not allowed).
      - 5) Gasketing shall be Grade "EHP" EPDM compound (red & green color coded) conforming to ASTM D-2000. Temperature operating range - 30°F to +250°F.
- B. Heating hot water piping 4" and larger shall be steel pipe: ASTM A53, Schedule 40, wall black steel, beveled ends for welding.
  - 1. Fittings: ASTM B16.3, malleable iron or STM A234, forged steel welding type fittings.
  - 2. Joints: AWS D1.1, welded.
- C. Heating hot water piping ½" through 2" may be Victaulic Vic Press 304™ System using EPDM "E" O- ring seals.
  - 1. Piping shall be stainless steel schedule 10S pipe conforming to ASTM A312, Type 304/304L [316/316L]. Working pressures to 500 psi.
  - 2. Coupling and fitting housings shall be Vic Press 304™ products formed of precision cold drawn stainless steel, with self contained O-ring seals in the coupling/fitting ends.

3. O-Ring Seals - O-ring seals shall be molded of synthetic rubber, Grade "E" EPDM recommended for water services from -30°F to +230°F.
  4. Valves - Victaulic or equal Style P589 Vic Press 304™ end ball valve, 300 psi, ½" through 2" size range, forged brass body, ASTM B-16 chrome plated ASTM B283 brass ball and stem, TFE seats and stem washer, Fluoroelastomer O-ring.
  5. Assembly- Pipe ends must be marked according to instructions supplied and fully inserted into the coupling/fitting housing up to the pipe stop. Fitting ends shall be pressed onto the pipe using only a Pressfit Tool (PFT-510 series) equipped with the proper size pressing jaws in accordance with the latest Pressfit System Product Assembly and Tool Operation Manual.
  6. Pipe Preparation - Stainless steel pipe shall be square cut plus or minus 0.030", properly deburred and cleaned to ensure leak-tight O-ring seal, in accordance with latest Victaulic Vic Press 304™ System published information.
- D. Heating hot water piping 2½" and larger may be Victaulic grooved piping system using EPDM gasketing as an option to welding, threading or flanging.
1. Piping shall be ASTM A53, schedule 40 black steel with mechanical grooves.
  2. All grooved components shall be of one manufacturer and shall conform to local code approval and/or as listed by ANSI B31.1, B31.9, ASME, UL/FM IAMPO or BOCA. Grooved end product manufacturer to be ISO-9001 certified.
  3. Roll or cut grooved ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends shall be grooved in accordance with manufacturers current listed standards conforming to ANSI/AWWA C606. Grooving tools shall be of the same manufacturer as the grooved components.
  4. Mechanical couplings shall consist of ductile iron housings, conforming to ASTM A395 and A536, complete with synthetic rubber gasket.
    - a. Victaulic style 07 (zero-flex) rigid coupling. Housings cast with offsetting, angle-pattern bolt pads to provide system rigidity for support and hanging in accordance with ANSI B31.1, B31.9 and NFPA 13. Victaulic style HP-70 rigid coupling for high pressure service.
      - 1) Installation ready, for direct stab installation without field disassembly, including grade EHP gasket. Victaulic Style 107.
    - b. Victaulic style 177 "Installation-Ready" and style 77 or 75 coupling shall be used where system flexibility is desired at pumps and other mechanical equipment to reduce noise and vibration. Noise and vibration reduction is achieved by installing (3) flexible couplings near the vibration source.
    - c. 14" and Larger: Victaulic AGS series two segment couplings with lead-in chamfer on housing key and wide width FlushSeal® gasket.
      - 1) Rigid Type: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07.
      - 2) Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement. Victaulic Style W77.

1. Mechanical reducing couplings shall be Victaulic Style 750 or equal for pipe runs for reducers.
2. Victaulic grooved end fittings manufactured from ASTM A395 and A536, ductile iron; ASTM A234 forged steel; or factory-fabricated from carbon steel pipe conforming to ASTM A53. Grooved ends in accordance with ANSI/AWWA C606.
3. Gasketing shall be grade EHP gasket suitable for water temperatures to +250°F or Grade "E" EPDM compound (green color coded) conforming to ASTM D-2000 designation 2CA615A25B24F17Z. Temperature operating range -30°F to +230°F.

## 2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Equipment drains, cooling coil drains, overflows and piping from relief valves 1" and smaller shall be Copper Tubing: ASTM B88, Type L, hard drawn.
  1. Fittings: ASME B16.18 cast brass tee tap or ASME B16.22 solder wrought copper.
  2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
- B. Equipment drains, cooling coil drains, overflows and piping from relief valves 1¼" thru 2" shall be ASTM A53, schedule 40 black steel with threaded joints.

## 2.3 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 23 05 00.

## 2.4 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for Pipe 3 Inches and Under:
  1. Copper Pipe: Bronze, soldered joints.
  2. Stainless Steel Pipe: Type 304/304L stainless steel, threaded-type, with Vic Press 304™ ends. Victaulic Style P584.
  3. On piping systems where grooved joint mechanical couplings are used, unions are not required. (Couplings shall serve as unions).
- B. Flanges for Pipe 4 Inches and Larger:
  1. Ferrous Piping: 150 psig forged steel, slip-on.
  2. Gaskets: 1/16 inch thick preformed neoprene.
- C. Flange Adapters for Grooved Pipe and Fittings 2 ½ Inches and Larger:
  1. Ferrous Piping: Class 125/150 for use with grooved end pipe and fittings. Victaulic Style 741/W741.
- D. Grooved and Shouldered Pipe End Couplings when approved by Architect/Engineer:
  1. Housing Clamps: Two ductile iron to engage and lock, designed to permit some angular deflection, contraction, and expansion where required.
  2. Sealing Gasket: C-shape elastomer composition for operating temperature range from -30 degrees F to 230 degrees F for EPDM Grade E gaskets, and EPDM-HP for operating temperature range from -30 degrees F to 250 degrees F.
  3. Accessories: Electroplated steel bolts, nuts, and washers conforming with ASTM A449.
  4. Basis of Design: Victaulic Style 47.

E. Dielectric Connections

1. Dielectric nipples shall be non-conducting for connection of dissimilar piping materials. Dielectric nipples shall be similar to Victaulic Style 647 or Style 47. A brass adaptor dielectric union is not acceptable.

2.7 GATE VALVES

A. Up To and Including 3 Inches:

1. Bronze body, bronze trim, screwed bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder ends.

B. Over 3 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends. (Grooved ends only if approved by Architect/Engineer.) Basis of Design: Victaulic Series 771V.

2.8 GLOBE OR ANGLE VALVES

A. Up To and Including 3 Inches:

1. Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat solder ends.

B. Over 3 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.9 BALL VALVES

A. Up To and Including 2 Inches:

1. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends.
2. Forged brass, two piece body, chrome plated brass ball and stem, PTFE seats and stem washer, lever handle, Vic Press 304™ ends. Victaulic Series P589.

B. Over 2½ Inches:

1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, flanged.
2. Ductile iron body, chrome plated carbon steel ball and stem, TFE seats, lever handle or gear operator, grooved ends. Victaulic Series 726.

2.10 PLUG VALVES

A. Up To and Including 3 Inches:

1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
2. Operator: One plug valve wrench for every ten plug valves minimum of one.

B. Over 3 Inches:

1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends or grooved ends if Victaulic grooved end fittings are used.



2. Ductile iron body and plug, standard port opening, non-lubricated eccentric-type, welded-in nickel seat, grooved ends. Victaulic Series 377.
3. Operator: Each plug valve shall have a wrench handle with set screw.

## 2.11 BUTTERFLY VALVES

- A. Body: PPS (Polypphenylene Sulfide) or enamel coated cast or ductile iron with resilient replaceable pressure responsive EPDM seat or disc mounted seal, wafer or lug ends or grooved ends if Victaulic grooved end fittings are used. Stem shall be offset from the disc centerline to provide full 360 degree circumferential seating.
- B. Disc: Aluminum bronze, electroless-nickel or PPS coated ductile iron or stainless steel.
- C. Operator: 10 position lever handle up to 4". Larger than 4" shall have gear drive handwheel.
- D. Basis of Design: Victaulic MasterSeal™ or AGS-Vic300.

## 2.12 SWING CHECK VALVES

- A. Up To and Including 3 Inches:
  1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
- B. Over 3 Inches:
  1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends or grooved ends if Victaulic grooved end fittings are used.

## 2.13 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.
- B. Ductile iron body, stainless steel spring and shaft, aluminum-bronze disc with elastomer seal or elastomer coated ductile iron disc with welded-in nickel seat, grooved ends. Basis of Design: Victaulic Series 716.

# PART 3 EXECUTION

## 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges, grooved joint couplings, or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

## 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.5 and B31.9.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Slope piping and arrange to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 1. For water systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the engineer). Where expansion loops are required, use Victaulic Style 77 couplings on the loops.
- I. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union and couplings for servicing are consistently provided.
- J. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- K. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s) ).
- L. Use grooved mechanical couplings and fasteners as approved by the Architect/Engineer.
- M. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- N. Use non-conducting dielectric nipples or couplings, whenever joining dissimilar metals.
- O. Provide pipe hangers and supports in accordance with ASTM B31.9 unless indicated otherwise.
- P. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers. All branch piping take-offs from mains, risers or branch piping shall have valves installed to allow isolation of branch piping and equipment/areas being served.

- Q. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
- R. Use butterfly valves interchangeably with gate and globe valves.
- S. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- T. Use lug or grooved end butterfly valves to isolate equipment.
- U. Use check valves or triple duty valves on discharge of pumps where shown on drawings.
- V. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- W. Use  $\frac{3}{4}$  inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- X. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- Y. Pipe Hangers and Supports:
  - 1. Install in accordance with ASTM B31.9, ASTM F708 and MSS SP89.
  - 2. Support horizontal piping as scheduled.
  - 3. Install hangers to provide minimum  $\frac{1}{2}$  inch space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches of each horizontal elbow.
  - 5. Use hangers with  $1\frac{1}{2}$  inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
  - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 8. Provide copper plated hangers and supports for copper piping.
  - 9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- Z. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- AA. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- BB. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

- CC. Apply one coat of primer and one coat of paint to all unfinished exposed pipe, fittings, supports and accessories. For example, unfinished piping exposed within a mechanical room, outdoors, within any room shall be primed and painted.
  - DD. Install valves with stems upright or horizontal, not inverted.
  - EE. Provide balancing devices where indicated on drawings, as required to attain design quantities, and as recommended by balancing agency.
  - FF. After filling system, check for leaks and repair to leak-tight condition.
  - GG. After completion, clean strainers, flush and fill systems and test system to be sure all air is eliminated from piping, coils, etc.
- 3.3 TESTING
- A. Hydrostatically test at 100 psi in excess of the working pressure for four (4) hours. This pressure to be on piping only, not on equipment.

END OF SECTION

MAI: 2022-1558

SECTION 23 21 16  
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Combination air and sediment separator.
- D. Strainers.
- E. Pump suction fittings.
- F. Combination fittings.
- G. Flow indicators, controls, meters.
- H. Relief valves.
- I. Temperature control valves.
- J. Glycol specialties.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use.

- A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

PART 2 PRODUCTS

2.1 AIR CONTROL SYSTEM

- A. Furnish and install as shown on the plans and as follows a complete Air Control System consisting of an ASME Compression Tank with Airtrol Fitting, Tank Drain and Gauge Glass Set. The installer shall remove and clean the system strainers after 24 hours operation and after 30 days operation. Furnish National Board Form U-1 denoting compliance with ASME Code.
- B. SRS Combination Air & Sediment Separator
  - 1. Furnish and install, as shown on the plans, a centrifugal type air and sediment removal separator. The unit shall have inlet and outlet connections tangential to the vessel shell. Vessel shell diameter is to be three times the nominal inlet/outlet pipe diameter. The unit shall have a solid separation efficiency of 98% of 200 mesh sand and water solution, and be capable of heavier-than-water, undissolved sediment

separation of at least 40 microns. The unit shall be capable of air separation and elimination.

2. The unit shall have a welded sump at the bottom to collect sediment separated out by centrifugal action. Connections are to be provided by the contractor to purge the unit of collected sediment either manually or automatically.
3. The air and sediment removal separator must be designed, constructed and stamped for 125 psig @ 350F in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors.
4. The air and sediment removal separator shall be manufactured by Bell & Gossett or equal by Patterson Pump Co.

C. Compression Tank

1. Furnish and install as shown on plans, a horizontal compression tank with two ½" NPT gauge glass tapings in one head and a minimum of two NPT tapings in the shell. The tank must be designed, constructed and stamped for at least 125 psig @ 650 F in accordance with Section VII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with The National Board of Boiler and Pressure Vessel Inspectors. The Compression tank shall be painted with one shop coat of air-dry enamel.
2. Each compression tank shall be manufactured by Bell & Gossett, Wessels, or engineer's pre-approved alternate.
3. Each tank shall be furnished with a Bell & Gossett model "Airtrol" Tank fitting and on tanks 135 gallon and less, a Bell & Gossett model "Drain-O-Tank" fitting.

- D. The Airtrol Tank Fittings and Air Separator are to be guaranteed for 20 years from the date of installation against defects in material and workmanship.

2.2 SAFETY RELIEF VALVES

A. Furnish and install as shown on plans a diaphragm-assisted operated bronze body ASME rated and nameplated safety relief valve with fail-safe disc to assure normal operation under emergency conditions. The valve shall have a low blowdown differential and shall be designed to relieve system pressure in excess of the operating pressure specified for the system, within the maximum operating limitations of the valve. The ASME safety relief valve shall be engineered to prevent the system fluid from entering the spring chamber under normal operating conditions. The permanent valve nameplate shall display the BTUH and relief pressure ratings certified by the National Board of Boiler and Pressure Vessel Inspectors. Manufacturer: Bell and Gossett or equal.

2.3 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with ball valve and Bell & Gossett #87 or equal automatic air vent piped to accessible location.

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2.4 TRIPLE DUTY VALVE

- A. Furnish and install, as shown on plans, Bell & Gossett or equal (select one: straight or angle) pattern triple duty valves designed to perform the functions of a center guided nonslam check valve, shutoff valve and calibrated balancing valve.
- B. The valve shall be of heavy-duty cast iron (NPT & flanged models) or ductile iron (grooved models) construction for operating temperatures up to 250 F and working pressure up to 175 psi. The valve shall be fitted with a bronze seat, replaceable bronze disc with EPDM seat insert or stainless steel stem, and chatter preventing stainless steel spring. The valve design shall permit repacking under full system pressure.
- C. Cv rating shall be provided at every 10% increment opening for the straight and angle valve. Manufacturer shall supply the Cv rating for read-out of flow determination and system pressure drop.
- D. The valve shall be equipped with brass readout valves (with integral check valve) to facilitate taking differential pressure readings across the orifice for accurate system balance. The valve shall be produced at an ISO 9001 approved facility.
- E. Triple Duty Valves shall be warranted for a period of one year from date of start-up, or eighteen months from installation, whichever occurs first.
- F. Triple-Duty Valve Assembly: Straight pattern, 300 psig pressure rating, ductile-iron body, pump discharge assembly consisting of a Victaulic MasterSeal butterfly valve with memory stop feature for shut-off and balancing and a Series 716 spring actuated check valve. Where flow measurement is required, a Victaulic Series 779 Venturi-check shall be used in lieu of the Series 716 check valve.
  - a. For 14" and larger sizes, AGS-Vic300 butterfly valve with a Series W715 check valve.

## 2.5 SUCTION DIFFUSER

- A. Furnish and install a Bell & Gossett or Patterson Pump Co. model SD or Victaulic Series 731 and W731 (for grooved end strainers) suction diffuser per size and capacities shown on plans.
- B. The suction diffuser is an angle pattern flow straightening fitting equipped with a combination diffuser-strainer-orifice cylinder, stainless steel flow straightening vanes, start up strainer, permanent magnet and base support boss on adjustable support foot. The diffuser shall have a total free area equal to five times the cross sectional area of the pump suction opening. The length of the flow straightening vanes shall be no less than 2½ times the diameter of the pump suction connection. Strainer shall have 5/32 or 3/16 perforations. Start up strainer shall be 20 mesh stainless steel. Straightening vanes shall run the full length of the diffuser.
- C. The suction diffuser shall be warranted to be free from defects in materials and/or workmanship for a period of one year from date of start-up, or eighteen months from installation, whichever occurs first.

## 2.6 STRAINERS

- A. Size 2 inch and Under:



1. Screwed brass body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2½ inch to 4 inch:

1. Flanged or grooved ductile iron body for 300 psig working pressure, Y pattern with 3/64, 1/16, or 1/8 inch stainless steel perforated screen. Basis of Design: Victaulic Style 732.

## 2.7 BALANCE VALVES AND ACCESSORIES

### A. Calibrated Manual Balance Valves

1. Are only required on air handling units with multiple coils served by one control valve, and on pump discharges in lieu of the triple duty valve.
2. Furnish and install as shown on plans with manufacturers recommendations model CB calibrated balance valves as manufactured by Victaulic / TA Hydronics. Other acceptable manufacturers: ITT Bell & Gossett, Griswold Controls, Preso Meters.
3. Pre-Set Balance Procedure - Valves to be designed to allow installing contractor to pre-set balance points for proportional system balance prior to start-up in accordance with pre-set balance schedule.
4. Valve Design Construction - All valves ½" to 2" pipe size to be of DZR brass (Ametal) body and 2-1/2" to 12" ductile iron body / globe valve construction or bronze body/brass ball construction with glass and fiber TFE seat rings. Valves to have differential pressure read out ports across valve seat area. Read out ports to be fitted with internal EPT inserts and check valves. Valve bodies to have ¼" NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings. Valves shall be designed for positive shutoff. Basis of Design: Victaulic Series 786 and 787 and 788 and 789.
5. Valves shall be designed for positive shutoff.
6. Design Pressure Temperature - All ½" - 3" NPT connection valves are rated for 300 psig at 230 degrees F. All ½" - 2" Sweat connection valves are rated for 200 psig at 230 degrees F.
7. Coil-Hook-up Connections: Victaulic Koil-Kits Series 799 or 79V may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve, Series 78Y Strainer-Ball, Series 78U Union-Port fitting, with Series 78T ball valve and required coil hoses. A Style 793 and/or 794 differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after commissioning.
8. 2 ½" - 16" Furnish and install as shown on the job plans, TA Series 788/789 balancing valves with provision for connecting to a portable differential (ft. of Head) pressure meter. Each meter connection shall have pressure/temperature probes. The balancing valves shall be Y-pattern globe style design with ductile iron body, all other wetted parts of nonferrous, pressure die cast Ametal®. Each valve shall provide three (3) functions. (1) precision flow measurement, (2) precision flow balancing, (3) shut-off feature, eliminating the need for an additional isolation valve. These valves shall have eight (1), twelve (12), sixteen (16), twenty (20) or twenty two

(22) 360° adjustment turns of the handwheel for precise setting with hidden memory feature to program the valve with precision tamper-proof balancing setting. Handwheel shall have digital readout. The handwheel can be installed in any position without affecting performance.

9. 300 psi/2065 kPa, Y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8,12,16,20 or 22 turn digital readout handwheel for balancing, hidden memory feature with locking tamper proof setting, and connections for portable differential meter. TA Series 788-STAF or 789-STAG.

B. Automatic Flow Control Valves

Acceptable Manufacturers: Victaulic, Griswold, ITT Bell & Gossett, Victaulic

1. Required where shown on drawings and also in the piping arrangement to each 3-way valve equipment coil to balance the flow in the common return of 3-way valves, domestic hot water returns, and condensate or boiler feed pump discharges. All other systems are balanced by the temperature control valves. Flow limiting valves are to be factory tagged for terminal unit that it is being installed on.
2. Automatic flow control valve cartridges shall automatically control flow rates with  $\pm 5\%$  accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Two operating pressure ranges shall be available with the minimum range requiring less than 2 PSID to actuate the mechanism.
3. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring, or the valve housing shall be made of DZR brass.
4. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. (Consult the factory for details).
5. All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.
6. Body Styles
  - a. Isolator Series Valve
    - 1) Isolator series valves, sizes 1/2" through 1-1/2", shall have a ASTM brass alloy body, rated at no less than 400PSI/250°F. Isolator series valves, sizes 1-1/2" Large through 3", shall have a CAST brass alloy body, rated at no less than 275PSI/250°F. These sizes shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end which will accept various end pieces. Available flow rates shall be from 0.25 GPM to 160.0 GPM.
    - 2) The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.
    - 3) The body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals and one EPDM o-ring for protection against chemicals and modulating temperature.

- 4) The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.
- b. Victaulic Series
  - 1) Series 76T ½ - 2"/15 - 50mm: The valve shall operate by means of an automatic balancing cartridge with replaceable orifice plate and internal diaphragm. The pressure class of the valve shall be 365 psi/PN25. The valve housing shall be made of DZR brass. Available with sweat adapters upon request (Series 76S).
  - 2) Series 76K ½ - 2"/15 - 50mm: The valve shall operate by means of an automatic balancing cartridge with replaceable orifice plate and internal diaphragm. The pressure class of the valve shall be 365 psi/PN25. The valve housing shall be made of DZR brass. The housing shall have one fixed threaded end and one union end. Available with sweat adapters upon request (Series 76S).
  - 3) Series 76B With Ball Valve Kit (Series 722) ½ - 2"/15 - 50mm: The valve shall operate by means of an automatic balancing cartridge with replaceable orifice plate and internal diaphragm. The pressure class of the valve shall be 365 psi/PN25. The valve housing shall be made of DZR brass. The valve includes a factory-installed and leak tested ball valve with handle. Available with sweat adapters upon request (Series 76S).
  - 4) Series 76V With Ball Valve Kit (Series 722) ½ - 2"/15 - 50mm: The valve shall operate by means of an automatic balancing cartridge with replaceable orifice plate and internal diaphragm. The pressure class of the valve shall be 365 psi/PN25. The valve housing shall be made of DZR brass. The housing shall have one fixed threaded end and one union end. The valve includes a factory-installed and leak tested ball valve with handle. Available with sweat adapters upon request (Series 76S).
- c. Wafer Style Valves
  - 1) Class 150 Wafer valves shall consist of a gray iron (ASTM A126-61T, Class 30) body and stainless steel flow control cartridge assemblies; shall be rated at 200 PSI/250°F; shall be mechanically compatible with ANSI B16.5-1968 150 lb. steel flanges; valve shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate; shall have single or multiple, parallel-installed stainless steel cartridge assemblies to provide rated flow rate; shall include all plated steel studs required for installation; shall be available in 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", and 24" sizes, with flow rates from 14.0 GPM to 11,000.0 GPM.
- d. Grooved End Valves shall consist of steel pipe, schedule 40 or greater, and stainless steel flow control cartridge assembly (assembled with grooved end clamp on 1" to 3" sizes); shall be rated at 400PSI/200°F; shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall have grooved ends compatible with Victaulic grooved end clamps; shall be permanently marked to show direction

of flow, shall have body tag to indicate model number and flow rate; shall be available in 1-1/4" through 20" sizes with flow rates from 3.0 GPM to 6,800.0 GPM.

- e. Or Series 76G 2½ - 12"/65 - 300mm: The valve shall operate by means of automatic balancing stainless steel cartridges with replaceable orifice plate and internal EPDM diaphragm. The pressure class of the valve shall be PN16/PN25. The valve housing shall be made of ductile iron type GGG40. The valve shall comply with flanges according to EN/ANSI standards. Features a No. 45R Flanged Adapter Nipple featuring a ductile iron body and hardware composed of zinc plated alloy steel.
  - f. Flange End
    - 1) Class 150 Flange End Valves shall consist of steel pipe with flange ends, and stainless steel flow control cartridge assembly; 230PSIG/300°F shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall have flange ends compatible with ANSI B 16.5-1968 150 lb. Steel flanges; shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate; shall be available in 2" through 20" sizes with flow rates from 14.0 GPM to 6,800.0 GPM.
    - 2) Or Victaulic Series 76F 2 - 32"/50 - 800mm The valve shall operate by means of automatic balancing stainless steel cartridges with replaceable orifice plate and internal EPDM diaphragm. The pressure class of the valve shall be PN16/PN25. The valve housing shall be made of ductile iron type GGG40. The valve shall comply with flanges according to EN/ANSI standards.
  - g. Threaded Iron Valves
    - 1) Threaded flange valves shall consist of gray iron (ASTM A126-61T, Class 30) body and stainless steel flow control cartridge assembly; shall be rated at 300 PSI/275°F shall have female NPT threaded flange end connections; shall be supplied with plated steel studs and nuts; shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall be permanently marked to show direction of flow; shall have body tag to indicate model number and flow rate; shall be available in 1/2", 2" and 2-1/2" sizes, with flow rates from 14.0 GPM to 150.0 GPM.
    - 2) Threaded high capacity valves shall consist of gray iron (ASTM A126-61T, Class 30) body and stainless steel flow control cartridge assembly; shall be rated at 200 PSI/250°F; shall have female NPT threaded end connections; shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes; shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate; shall be available in 3" size, with flow rates from 14.0 GPM to 450.0GPM.
7. Strainers
- a. Isolator or Victaulic 78Y - Strainer (Combination Union Ball Valve and Y-Strainer)

- 1) Strainer shall be supplied a part of a Coil Piping Package on the inlet to each terminal device whether it is two-way or three-way. These packages shall be factory shrink wrapped and tagged along with the control valve or balance valve at the factory for easy field identification and installation.
  - 2) Strainer shall be Y-type configuration made of DZR brass. Maximum pressure rating of 400 PSI. Strainer shall include a union end which will accept various end pieces.
  - 3) The body design shall allow inspection or removal of 20 mesh stainless steel strainer without disturbing piping connections and hose end connection for proper draining.
  - 4) The body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals and one EPDM o-ring for protection against chemicals and modulating temperature.
  - 5) A pressure/temperature test valve and manual air vent shall be standard.
  - 6) Isolator S shall be offered with blow down option.
8. Differential Pressure Controllers
- a. Differential Pressure Control Valves 1/2" through 2":
    - 1) Maximum differential pressure is 51 psi / 350 kPa, maximum temperature is 248°F / 120°C for use in heating and cooling systems only. NPT threaded valve body and bonnet shall be manufactured of Ametal® copper alloy, O-rings, seat seal, and membrane manufactured of HBNR. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, polymide handle, and drain if required by project engineer.
    - 2) Shall be capable of stabilizing  $\Delta pV$  ranges of 1.5- 8.7 psi/10-60 kPa in sizes 3/4-1"/15-25 mm or 2.9- 11.6 psi/23-80 kPa in sizes 1 1/4- 2"/32-50 mm, as determined by project engineer or certified Victaulic/TA representative. TA Series 786- STAD, TA Series 787-STAS, TA Series 788-STAG, TA Series 789-STAF dependent on system size and connection requirements.
    - 3) Capillary tube, hose kit, and all connection fittings shall be manufactured by Tour and Andersson to ensure proper operation of installed STAP valves. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified Victaulic/TA representative.
  - b. Differential Pressure Control Valves 2 1/2" through 4":
    - 1) Maximum differential pressure 51 psi/350 kPa, maximum temperature is 176°F / 80°C for use in heating and cooling systems only. ANSI Class 150 flange body to be cast of ductile iron and bonnet shall be manufactured of Ametal® copper alloy, O-rings, seat seal, and membrane manufactured of EPDM. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, polymide handle, and drain if required by project engineer.

- 2) Shall be capable of stabilizing  $\Delta pV$  ranges of 2.9-11.6 psi/20-80 kPa for spring option 1 and 5.8-23.3 psi/40-160 kPa for spring option 2, as determined by project engineer or certified Victaulic/TA representative. TA Series 786- STAD, TA Series 787-STAS, TA Series 788-STAG, TA Series 789-STAF dependant on system size and connection requirements. Capillary tube, hose kit, and all connection fittings shall be manufactured by Tour and Andersson to ensure proper operation of installed STAP valves. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified Victaulic/TA representative.
  - c. Differential Pressure Controller Assembly
    - 1) The manufacturer shall provide assistance to the mechanical and balancing contractors to aid in the installation, initial setup and adjustment of DP controller assembly devices. This assistance shall be provided only by the manufacturer's authorized representative.
    - 2) The initial flow rate balancing setup information shall be calculated on factory-approved hydraulic software for each device by the manufacturer and provided to the contractors. The manufacturer shall identify each component with installation location.
    - 3) The manufacturer shall provide on-site assistance to the contractors during installation and balancing of the project.
9. Accessories
- a. Meter kit shall be provided if scheduled as either a permanently mounted or as a single-hose portable or double-hose portable kit; pressure gauge with 4-1/2" dial shall have range of -14.7 to 150 PSI; portable kits shall be available with end connections for either pressure only or pressure/temperature test valves and shall include carrying cases; all kits shall include flow rate chart for determining flow rate.
  - b. Identification tags shall be available for all valves; tags shall be indelibly marked with flow rate, model number, zone identification: tags shall be 3" x 3" aluminum.
  - c. Pressure/temperature test valves or pressure only test valves shall be available at 1/4" NPT for measuring pressure or temperature in fluid systems.
  - d. Hoses
    - 1) All hoses shall be equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings. Serrated/slip fit connections are not acceptable.
    - 2) Flame Retardant Hoses
      - I. Hose materials shall be stainless steel braided over an EPDM liner.
      - II. Hoses shall meet or exceed the ASTM-D380-83 standard and withstand working pressures of 375 PSI (1/2"), 300 PSI (3/4", 1", 1-1/4") at 211°F and 300 PSI (1-1/2", 2") at 200°F
      - III. Hoses shall meet or exceed flame retardant testing per standards UL #723, NEPA #225, ANSI 2.5, UBC 42-1, and ASTM-E84A. after ten

minutes and produce less than 5% smoke as compared to Red Oak flooring (100%)

3) Insulated Hoses

- I. Hose materials shall be high quality polyethylene pipe insulation over a stainless steel braided inner core and withstand working pressure of 375 PSI (1/2"), 300 PSI (3/4", 1", 1-1/4") at 211°F and 300 PSI (1-1/2", 2") at 200°F.

2.8 TEMPERATURE CONTROL VALVES

- A. Control valves shall be furnished by Temperature Control Contractor and installed by Mechanical Contractor. See Temperature Control System section for requirements.

2.9 GLYCOL FEED UNIT

- A. Furnish and install the glycol feed unit according to plans and manufacturer's instructions. Unit shall consist of one phenolic plastic receiver including fill opening and level markings. Contractor shall drill top openings as required for system relief valve discharge tube, glycol pump discharge hose and power cord. 15' long power cord, 15' long relief valve discharge tube and 15' long glycol pump discharge hose shall be furnished with feed unit. Contractor shall set the receiver on a concrete housekeeping pad.
- B. The glycol feed pump shall be a submersible model SE85 as manufactured by Bell & Gossett. The pump casing and impeller shall be cast iron construction, and the shaft shall be corrosion resistant stainless steel. The mechanical seal shall be silicon carbide by silicon carbide sealing faces, with BUNA-N elastomers. The motor shall be fully submerged in high-grade turbine oil for lubrication and efficient heat transfer. Motor shall be  $\frac{3}{4}$  horsepower, 115 volt, with Class B insulation, built-in overload with automatic reset, and capacitor start.
- C. The diaphragm operated expansion tank, shall be factory pre-charged at 25 psig (field adjustable), 60 psig maximum operating pressure, with baked epoxy finish. Note: Contractor shall connect tank between PRV and fill connection. Contractor shall field set the pre-charge pressure as recommended by the feed system manufacturer.
- D. The pressure reducing valve shall be furnished with the feed unit and installed by the Contractor. It shall be diaphragm operated with inlet side pressure check valve and inlet side strainer. The strainer must be easily removed without system shut-down. The valve seat, strainer and stem must be removable and of non-corrosive material. Body to be of brass construction. PRV shall be adjusted by the contractor as recommended by the feed system manufacturer. Contractor shall furnish and install ball valve in bypass around PRV and ball shutoff valve ahead of bypass and PRV.
- E. The check valve shall be of the spring loaded silent type mounted by the Contractor on the pump discharge.
- F. Low level cutoff shall be a mechanical, non-mercury float switch furnished and factory wired to pump.
- G. A pressure operated limit switch shall be furnished with the feed units and installed by the Contractor to maintain a positive fill pressure equal to or greater than 25 psig.

- H. All wiring shall be the responsibility of the Electrical Trades who will furnish and install a manual motor starter, wire the starter to the pressure switch and connect the pump power cord to the pressure switch.
- I. Unit shall be manufactured by Wessels or Bell & Gossett.

## 2.10 GLYCOL SOLUTION

- A. Contractor shall fill the glycol piping systems and the glycol feed tank with a mixture of ethylene glycol and water. Mixture shall be 33% glycol for chilled water systems and 40% glycol for snow melt systems. Glycol shall be Dowtherm as manufactured by the Dow Chemical Co. or equal, with annual testing service offered by the manufacturer. System and feed tank shall be full at completion of project. A pressure relief valve shall be furnished with the feed unit and installed by the Contractor. Relief valve discharge shall be piped into the top of the glycol feed tank.
- B. If glycol/water mixture is required, clean and flush glycol system before adding glycol solution. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Perform tests determining strength of glycol and water solution and submit written test results.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Grooved end installations
  1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
  2. All castings used for coupling housings, fittings, valve bodies, etc. shall be date stamped for quality assurance and traceability.
  3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- C. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- D. Provide manual air vents at system high points that could "trap" air in piping system and as indicated.
- E. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- F. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- G. Provide valved drain and hose connection on strainer blow down connection.
- H. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.



- I. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
- J. Support pump fittings with floor mounted pipe and flange supports.
- K. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- L. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- N. After completion, clean strainers, flush and fill systems.

### 3.2 TESTING

- A. Hydrostatically test piping at 100 psi for four (4) hours. This pressure to be on piping only, not on equipment.

END OF SECTION

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SECTION 23 21 23

HVAC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Circulating pumps.
- B. Miscellaneous pump equipment.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 PERFORMANCE REQUIREMENTS

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 CIRCULATING PUMP.

- A. Refer to drawings and furnish all.

2.2 INLINE CIRCULATING PUMP

- A. Furnish and install pumps with capacities as shown on plans. Pumps shall be inline type for installation in vertical or horizontal piping. Pump must be capable of being serviced without disturbing piping connections.
- B. Pump body shall be of Class 30 cast iron, rate 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports.
- C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew or nut.
- D. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat, and carbon seal ring, suitable for continuous operation of 225°F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.
- E. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces, a flexible coupling to dampen starting torque and torsional vibrations shall be employed.

- F. Motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans.
- G. Each pump shall be factory tested. It shall then be painted with at least one coat of high-grade machinery enamel prior to shipment.
- H. Pump shall be Series 60 as manufactured by ITT Bell and Gossett or equal.

## 2.3 INLINE CLOSE COUPLED PUMP

- A. Furnish and install pumps with capacities as shown on plans. Pumps shall be inline type, close coupled, single stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.
- B. Pump volute shall be of Class 30 cast iron. The impeller shall be of bronze enclosed type, dynamically balanced, keyed and secured to the shaft by a locking or nut.
- C. The liquid cavity shall be sealed off at the motor shaft by an externally flushed mechanical seal with a ceramic seal seat of at least 98% alumina oxide content, and carbon seal ring. Seal shall be suitable for continuous operation at 250°F. A bronze shaft sleeve shall completely cover the wetted area under the seal. Pumps shall be rated for a minimum of 300 psi working pressure at 100°F. Casings shall have vent and drain ports, and gauge tappings at nozzles.
- D. Motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans. Motor shall have heavy duty grease lubricated ball bearings, completely adequate for the maximum load for which the motor is designed.
- E. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.
- F. Each pump shall be checked by the Contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to the pump for Owner's reference.
- G. Pumps shall be Series "80" as manufactured by ITT Bell and Gossett or Patterson Pump Co.

## 2.4 INLINE CIRCULATING PUMP

- A. Furnish and install pumps with capacities shown on plans. Pumps shall be inline type, close coupled, single stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.
- B. Pump volute shall be of Class 30 cast iron. The impeller shall be of bronze enclosed type, dynamically balanced, keyed and secured to the shaft by a locking or nut.
- C. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225°F. A shaft sleeve shall completely cover the wetted area under the seal.

- D. Pump shall be rated for minimum of 175 psi working pressure. Volute shall have gauge ports at nozzles, vent and drain ports in the volute.
- E. Motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans. It shall have heavy duty greased lubricated ball bearings, completely adequate for the maximum load for which the motor is designed.
- F. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.
- G. Pump shall be Series 90 as manufactured by ITT Bell and Gossett or Patterson Pump Co.

## 2.5 BASE MOUNTED PUMP

- A. Furnish and install, as shown on plans, Bell & Gossett Series 1510 end suction base mounted centrifugal pumps with sizes, capacities, and characteristics as listed on equipment schedules.
- B. Pumps shall be base mounted, single stage, end suction design with integrally cast pedestal volute support to allow removal and service of the entire rotating assembly without disturbing the pump piping, electrical motor connections or pump to motor alignment. Pumps with bearing assembly supports only shall not be acceptable.
- C. Pump bearings shall be re-greaseable without removal of the bearings from the bearing assembly. Pumps shall be rated for 175 psi at 225°F. Working pressures shall not be derated at temperatures up to 250°F.
- D. Pump volute shall be Class 30 cast iron with integral gauge tapping at suction and discharge flanges, vent tapping and volute drain. The impeller shall be cast bronze of the enclosed type, dynamically balanced, keyed to the shaft and secured with a locking capscrew.
- E. The liquid cavity shall be sealed off at the pump shaft by an internally flushed mechanical seal with ceramic seat and carbon seal ring, suitable for continuous operation at 225 F. A replaceable bronze shaft sleeve shall completely cover the wetted area under the seal. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.
- F. Pump base shall be fabricated steel channel, fully enclosed, with securely welded cross members. Pump motor shall be mounted directly to a steel saddle. Grouting area shall be fully open. The combined pump and motor baseplate shall be sufficiently stiff as to limit the susceptibility of vibration. The minimum baseplate stiffness shall conform to ANSI/HI 1.3.4-1997 for Horizontal Baseplate Design standards.
- G. A flexible type, center drop-out design coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupler sleeve. The coupling shall be shielded by a dual rated ANSI B15.1, Section 8 & OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling.
- H. Motor shall meet NEMA and EPACT'92 (where applicable) specifications and shall be of the size, enclosure, voltage and RPM as shown in motor specification section and plans,

completely adequate for the maximum load for which the pump will operate. Motors shall be non-overloading across the entire operating range of the impeller. Pump and motor shall be factory aligned and hydrostatically tested per Hydraulic Institute standards. It shall be thoroughly cleaned and painted with at least one coat of high grade paint prior to shipment.

- I. The pumps shall be manufactured, assembled and tested in an ISO 9001 approved facility.
- J. All pumps with horsepower as noted below shall be laser aligned in the field by a manufacturer's representative prior to being put into service. The Alignment shall be performed after the pump piping has been completed and the baseplate has been grouted. Maximum acceptable shaft tolerances shall be as follows:

| <u>Motor Speed</u> | <u>Horsepower</u> | <u>Angularity in Mils/Inch</u> | <u>Offset in Mils</u> |
|--------------------|-------------------|--------------------------------|-----------------------|
| 3600               | All               | .5 / 1"                        | 3.0                   |
| 1800               | 7.5 & Up          | .7 / 1"                        | 5.0                   |
| 1200               | 15 & Up           | 1.0 / 1"                       | 7.0                   |

- K. Test equipment printed report indicating the final pump shaft tolerances shall be furnished to the engineer prior to project completion. "Rim-face" methods using single dial indicators, and "Reverse dial" methods using double indicators shall not be accepted.
- L. Pumps shall be warranted for a period of one year from date of start-up, or eighteen months from installation, whichever occurs first.
- M. Pumps shall be Series 1510 as manufactured by ITT Bell & Gossett or Patterson Pump Co.

#### 2.13 MISCELLANEOUS PUMP EQUIPMENT

- A. Flexible Pump Connectors shall be Metroflex SS or Neoprene as recommended by the manufacturer.
  - 1. Stainless steel flexible connectors shall be manufactured of 300 series stainless steel convoluted metal bellows with 150# AS drilled bolts. All of the bellows are to be filled with Sioflex rubber and the integral gaskets are to be vulcanized to the flange surfaces. The connectors shall be sized (eg. 3") with the O/A dimension to be full live length. They shall be pressure tested at 225 psi and suitable for 300°F.
  - 2. Neoprene connectors shall be Model MSRC Cablesphere.
- B. Pump Pressure Indicator System:
  - 1. Provide Flow Conditioning Corp. Hydronic Indicator Systems as shown on plans. These systems shall consist of Hydronic Indicators and Trumpet Valves to provide accurate pressure indications where necessary.
  - 2. Hydronic Indicator shall meet ASA Grade A specifications for pressures gauges, accurate to 1%. Case shall be 4-1/2" diameter, stem mounted, heavy steel with screwed ring and unbreakable crystal. Indicator shall have recalibrator, compound scale calibrated both in pounds and feet from full vacuum to selected pressure, and quick set dial for pressure comparison. Maximum indicator pressure shall at least

equal pump shut off head (when system pressure is at relief valve setting) and shall exceed this minimum by no more than 50 psi.

3. Trumpet valve shall be spring return pushbutton manifold of rugged brass construction with ports for connection to system at indicated points and with test port connection for gauge calibration.
4. Hydronic Indicator System shall be attached to system piping with heavy bracket and convenient height to permit easy pushbutton operation and dial observation.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducing couplings. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- D. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized combination pump discharge valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base mounted pumps prior to start-up.
- H. Install close coupled and/or base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.
- I. Lubricate pumps before start-up.
- J. Prior to initial start-up, the pump representative shall be notified that all pumps are wired, lubricated, system filled, and ready for check test and alignment. A complete report shall be submitted to the Engineer covering the following:
  1. Rotation Check
  2. Base Grouted
  3. Approved Piping
  4. Voltage Check \_\_\_\_\_ Volts
  5. Suction Pressure \_\_\_\_\_ psig
  6. Discharge Pressure \_\_\_\_\_ psig

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7. Actual Pump gpm \_\_\_\_\_ head \_\_\_\_\_ ft.
  8. Amps L1 \_\_\_\_\_ L2 \_\_\_\_\_ L3 \_\_\_\_\_
  9. Motor Hp \_\_\_\_\_
  10. Any difficulties of operation.
- K. Complete instructions/training on operation and maintenance of the circulating pump system shall be provided to the Owner by the circulating pump representative to the satisfaction of the Owner/Engineer prior to project close-out and final payment.

END OF SECTION

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SECTION 23 25 00

HVAC SYSTEMS TESTING, CLEANING, WATER TREATMENT & STARTUP

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing of piping systems.
- B. Cleaning of piping systems.
- C. Chemical feeder equipment.
- D. Chemical treatment.
- E. Substantial completion check list and sign-off forms.

1.2 PRODUCTS FURNISHED, BUT NOT INSTALLED, UNDER THIS SECTION

- A. Chemical shot feeder, glycol feed system, placement of water coupon rack, etc. shall be furnished by the contractor responsible for chemical treatment of the systems, installed by the Mechanical Trade. Shot feeder shall be installed at a serviceable, low height.

1.3 QUALIFICATIONS

- A. The chemical treatment company shall specialize in water treatment of mechanical systems. The company shall have local representatives with water analysis laboratories and full time service personnel.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for public sewage systems.
- B. Products requiring electrical connection and listed and classified by UL as suitable for the purpose specified and indicated.

1.5 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems and system water for one year from date of substantial completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report to Owner after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.



- D. Provide training course for Owner's personnel, instructing them on installation, care, maintenance, testing, and operation of the water treatment systems. Arrange course at startup of systems.
- E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based on these inspections.

#### 1.6 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

### PART 2 PRODUCTS

#### 2.1 BYPASS (POT) FEEDER

- A. 5.0 gallon quick opening cap for working pressure of 175 psig. See drawings for additional information.

#### 2.2 DRIP FEEDER

- A. Plastic reservoir with coil of capillary tubing with probe, weight, charging syringe, and clip.

#### 2.3 SOLUTION METERING PUMP

- A. Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous duty fully enclosed electric motor and drive, and built in relief valve.

#### 2.4 SOLUTION TANKS

- A. 50 gallon capacity, polyethylene, self-supporting, 5 gallon graduated markings; molded fiberglass cover with recess for mounting pump, agitator, and liquid level switch.

#### 2.5 AGITATOR

- A. Totally enclosed electric motor, cast iron clamp and motor mount, 5/8 inch diameter Type 316 stainless steel propeller.

#### 2.6 LIQUID LEVEL SWITCH

- A. Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low level alarm.

#### 2.7 CONDUCTIVITY CONTROLLER

- A. Packaged monitor controller with solid state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control function light, output to control circuit and recorder.

#### 2.8 WATER METER

- A. Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

## 2.9 SOLENOID VALVES

- A. Forged brass body globe pattern, normally open or closed as required, general purpose explosion-proof and watertight solenoid enclosure, and continuous duty coil.

## 2.10 TIMERS

- A. Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with hands-off-automatic switches and status lights.

## 2.11 TEST EQUIPMENT

- A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4-10 ml, zeroing titrating burettes and associated reagents.
- B. Provide the following test kits:
  - 1. Alkalinity titration test kit.
  - 2. Chloride titration test kit.
  - 3. Sulphite titration test kit.
  - 4. Total hardness titration test kit.
  - 5. Low phosphate test kit.
  - 6. Conductivity bridge, range 0-10,000 microhms.
  - 7. Creosol red pH slide complete with reagent.
  - 8. Portable electronic conductivity meter.
  - 9. High nitrite test kit.

## PART 3 - EXECUTION

### 3.1 HEATING HOT WATER PIPING SYSTEMS

- A. Testing
  - 1. Before equipment is connected, hydrostatically test at 1.5 times the maximum system pressure, but not less than 100 psig in excess of the working pressure for four hours. This pressure to be on piping only, not equipment.
- B. Cleaning and Flushing
  - 1. Systems shall be operational, filled, started and vented prior to cleaning. Use water meter and record capacity in system.
  - 2. Place terminal control valves in open position during cleaning.
  - 3. Verify that electric power is available and of the correct characteristics.
  - 4. Install cleaning chemicals. Concentration shall be one pound per 100 gallons of water or as recommended by manufacturer of chemicals.
    - a. Utilize liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
    - b. Utilize biocide; chlorine release agents such as sodium hypochlorate or calcium hypochlorite, or micro biocides such as quarteratany ammonial compounds, tributyl tin oxide, emthlene bis (thiocyanate), or isothiazolones.
  - 5. Apply heat where circulating, slowly raising water temperature to 160°F and maintain for 12 hours minimum.

6. Remove heat and circulate until water temperature is 100°F or less. Drain system as quickly as possible and refill with clean water.
7. Circulate for 6 hours at design temperature, then drain. Flush with clean water for one hour. Refill with clean water and repeat until system cleaner and all material is removed. Water shall be clear upon last drain.
8. Use neutralizer agents as recommended by the system cleaner supplier.
9. Remove, clean and replace strainer screens.
10. Inspect, remove sludge, and flush low points of piping system with clean water after cleaning process is completed. Include disassembly of components as required.
11. Install sequestering agent to reduce deposits and adjust pH. Install corrosion inhibitors and conductivity enhancers. All chemical treatment shall be as recommended by manufacturers and chemical treatment contractor. If system is to utilize a glycol water mixture, the glycol shall contain the sequestering agent and corrosion inhibitors.

C. System Water Treatment

1. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
2. Introduce chemicals through bypass feeder when required or indicated by a test.
3. Provide  $\frac{3}{4}$ " water coupon rack around circulating pumps with space for four test specimens.

3.2 SYSTEM COMPLETION CHECKLIST

- A. The checklist which follows this specification section is to be considered part of the specifications.
- B. The checklist is to be completed by the Installing Contractor and the prime Mechanical Contractor for each item as directed.

END OF SECTION

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MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN**SYSTEMS COMPLETION  
CHECKLIST**

| Inspection/Review Item        | Notice Required | Installing Contractor |           | Date | Owner's Representative Signature | Remarks  |
|-------------------------------|-----------------|-----------------------|-----------|------|----------------------------------|--|
|                               |                 | Name                  | Signature |      |                                  |  |
| <b>Rooftop Units</b>          |                 |                       |           |      |                                  |  |
| Gas Heat Exchanger            | When Completed  |                       |           |      |                                  | Verify heat exchangers have been piped properly per drawings and thoroughly cleaned of all construction dust and debris.   |
| Spring Isolator Roof Curb     | When Completed  |                       |           |      |                                  | Verify all shipping blocking has been removed and curb has been flashed properly.  |
| Duct Connectors               | When Completed  |                       |           |      |                                  | Verify all duct connections to unit are complete and that flex duct connections were used.   |
| Motorized Dampers             | When Completed  |                       |           |      |                                  | Verify linkages are free to operate and temperature control operation is correct.  |
| Duct Smoke Detectors          | When Completed  |                       |           |      |                                  | Verify duct smoke detectors have been installed and are operational.   |
| Temperature Controls          | When Completed  |                       |           |      |                                  | Verify all temperature control points have been installed and are operational.   |
| Identification                | When Completed  |                       |           |      |                                  | Verify AHU properly identified and labeled per specification.  |
| Cooling Coil Condensate Drain | When Completed  |                       |           |      |                                  | Verify P-trap on drain is piped correctly with minimum depth of seal greater than total static pressure possible by RTU. Verify drain pipe extended to roof drain. |

By signing this form, the Contractor is certifying that he has personally witnessed completion of that item, and it is complete and complies with all respects to the drawings and specifications.

All items are to be signed off on and submitted to MacMillan Associates Inc. before a final project walk-thru by the Engineer is requested. If the Engineer discovers items incomplete and/or not in accordance with this checklist, the drawings, or the specifications, the Contractor will be backcharged for the Engineer's time and expenses.

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PROJECT NO. 2022006.1

|                    |                |  |  |  |  |  |
|--------------------|----------------|--|--|--|--|--|
| MIDLAND COUNTY ESA |                |  |  |  |  |  |
| MIDLAND, MICHIGAN  |                |  |  |  |  |  |
| Filters            | When Completed |  |  |  |  | Verify prefilters and final filters are clean and ready for final air balance. |
| Supply Fans        | When Completed |  |  |  |  | Verify proper rotation and operation.  |

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NEW ADDITION AND RENOVATION FOR:

PROJECT NO. 2022006.1

MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN**SYSTEMS COMPLETION  
CHECKLIST**

| Inspection/Review Item       | Notice<br>Required | Installing Contractor |           | Date | Owner's<br>Representative<br>Signature | Remarks   |
|------------------------------|--------------------|-----------------------|-----------|------|--|---|
|                              |                    | Name                  | Signature |      |  |   |
| <b>HVAC Ductwork Systems</b> |                    |                       |           |      |  |   |
| Ductwork Inspection          | When Completed     |                       |           |      |  | Verify all joints have been sealed, connectors made, etc.                         |
| Balance Dampers              | When Completed     |                       |           |      |  | Verify balance dampers are installed at each duct branch and duct take-off.       |
| Fire and Smoke Dampers       | When Completed     |                       |           |      |  | Verify dampers are operational and open prior to air handling system operation.   |
| Louvers, Hoods, Exhaust Fans | When Completed     |                       |           |      |  | Verify installation is complete, all caulking, roofing etc. has been completed.   |
| Flexible Ductwork            | When Completed     |                       |           |      |  | Verify flex duct installed without "kinks" and have maximum 5'-0" length.         |
| Duct Insulation              | When Completed     |                       |           |      |  | Verify all insulation has been installed and sealed on duct systems as specified. |
| Duct Cleaning                | When Completed     |                       |           |      |  | Verify all dust, dirt and debris are removed from ducts.                          |
| Diffusers and Registers      | When Completed     |                       |           |      |  | Verify installation is complete and properly supported.                           |

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NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

| COMPLETION<br>SYSTEMS CHECKLIST                                    |                    |                       |           |      |  |   |
|--|--------------------|-----------------------|-----------|------|--|---|
| Inspection/Review Item   | Notice<br>Required | Installing Contractor |           | Date | Owner's<br>Representative<br>Signature | Remarks   |
|  |                    | Name                  | Signature |      |  |   |
| <b>HVAC Piping and Circulating Pump Systems</b>                    |                    |                       |           |      |  |   |
| Flushing and testing of heating hot water piping system            | 48 hours           |                       |           |      |  | Flushed and tested per specification.   |
| Flushing and testing of refrigerant piping system                  | 48 hours           |                       |           |      |  | Flushed and tested per specification.   |
| Valving  | When completed     |                       |           |      |  | Verify that all valves have been installed at all branch locations.   |
| Pipe and Fitting Insulation  | When Completed     |                       |           |      |  | Verify all piping and fittings are per specification.   |
| Circulating pumps installation complete, check, tested and started | 7 days             |                       |           |      |  | Verify circulating pump rotation, operation and control are correct. Verify check, test and start-up of circulating pumps by manufacturer's representative. |
| Circulating pump V.F.D. System                                     | 7 days             |                       |           |      |  | Verify installation complete for all control components, system check tested and started by manufacturer's representative.                                  |
| Glycol feed unit   | 7 days             |                       |           |      |  | Verify installation complete, system check, test and startup by   |

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NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

|  |                    |                       |           |      |  | manufacturer's representative.   |
|--|--------------------|-----------------------|-----------|------|--|--|
| <b>SYSTEMS COMPLETION<br/>CHECKLIST</b>                    |                    |                       |           |      |  |  |
| Inspection/Review Item                                     | Notice<br>Required | Installing Contractor |           | Date | Owner's<br>Representative<br>Signature | Remarks  |
|  |                    | Name                  | Signature |      |  |  |
| <b>HVAC Piping and Circulating Pump Systems, Continued</b> |                    |                       |           |      |  |  |
| Air Vents  | When<br>completed  |                       |           |      |  | Verify air vents at all high points of hydronic piping systems and all air bled from system. |
| Labeling and valve tagging identification                  | When<br>completed  |                       |           |      |  | Verify system identification is complete per specification.                                  |
| Owner's training   | When<br>completed  |                       |           |      |  | Verify that Owner has been instructed on operation and maintenance of systems.               |

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NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

**SYSTEMS COMPLETION  
CHECKLIST**

| Inspection/Review Item | Notice Required | Installing Contractor |           | Date | Owner's Representative Signature | Remarks   |
|------------------------|-----------------|-----------------------|-----------|------|----------------------------------|---|
|                        |                 | Name                  | Signature |      |                                  |   |
| Exhaust Fans           |                 |                       |           |      |                                  |   |
| Exhaust Fans           | At Completion   |                       |           |      |                                  | Verify fans installed properly on roof curb and curb completely flashed.                |
| Exhaust Fans           | At Completion   |                       |           |      |                                  | Verify proper fan rotation.   |
| Exhaust Fans           | At Completion   |                       |           |      |                                  | Verify fans are controlled by the temperature control system and have proper operation. |

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NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

**SYSTEMS COMPLETION  
CHECKLIST**

| Inspection/Review Item                      | Notice Required               | Installing Contractor |           | Date | Owner's Representative Signature | Remarks           |
|---|-------------------------------|-----------------------|-----------|------|----------------------------------|-------------------|
|   |                               | Name                  | Signature |      |                                  |                   |
| <b>Miscellaneous Requirements</b>           |                               |                       |           |      |                                  |                   |
| As-built drawings of all systems            | At completion of installation |                       |           |      |                                  | Per specification |
| Operation and Maintenance manuals           | At completion of installation |                       |           |      |                                  | Per specification |
| Air Balance Report                          | At completion of installation |                       |           |      |                                  | Per specification |
| Water Balance Report                        | At completion of installation |                       |           |      |                                  | Per specification |
| One complete set of shop drawings for Owner | At completion of project      |                       |           |      |                                  | Per specification |
| Inspection, local authority approvals, etc. | At completion of project      |                       |           |      |                                  |                   |

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SC-3

SECTION 23 30 00

AIR DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork
- B. Nonmetal ductwork.
- C. Single wall spiral duct and fittings
- D. Dampers.
- E. Duct cleaning.
- F. Roof hoods, exhaust fans, grilles and louvers.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ASTM A36 - Structural Steel.
- B. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. ASTM A366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
- D. ASTM A480 - General Requirements for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A525 - General Requirements for Steel Sheet.
- F. ASTM A527 - Steel Sheet, Zinc Coated (Galvanized) by Hot Dip Process, Lock Forming Quality.
- G. ASTM A568 - Steel, Sheet, Carbon, and High-Strength, Low Alloy, Hot-Rolled and Cold-Rolled.
- H. ASTM A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
- I. AWS D9.1 - Welding of Sheet Metal.
- J. NFPA 54 - National Fuel Gas Code.
- K. NFPA 70 - National Electric Code.
- L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

- M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
  - N. SMACNA - HVAC Air Duct Leakage Test Manual.
  - O. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
  - P. SMACNA - Fibrous Glass Duct Construction Standards.
  - Q. UL 33 - Heat Responsive Links for Fire Protection Systems.
  - R. UL 181 - Factory-Made Air Ducts and Connectors.
  - S. UL 555 - Fire Dampers and Ceiling Dampers.
- 1.3 SCOPE
- A. The work covered by this specification consists of furnishing all labor, equipment, materials and performing all operations required, for the correct and complete fabrication and installation of ductwork in accordance with the applicable project specifications, drawings, codes, regulations and standards.
- 1.4 PERFORMANCE REQUIREMENTS
- A. No variation of duct configuration or sizes will be permitted except by written permission from the Engineer. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- 1.5 QUALITY ASSURANCE
- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed.
  - B. Maintain one copy of document on site.
- 1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
  - B. Installer: Company specializing in performing the work of this section with minimum five years experience.
- 1.7 REGULATORY REQUIREMENTS
- A. Construct ductwork to NFPA 90A and SMACNA standards, latest edition.
- 1.8 ENVIRONMENTAL REQUIREMENTS
- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

- B. Maintain temperatures during and after installation of duct sealants.

## PART 2 PRODUCTS

### 2.1 DUCT - SHEET METAL HVAC DUCTWORK

- A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.
- B. Fasteners: Rivets, bolts, or sheet metal screws.
- C. Sealant:
  - 1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic. All ductwork joints, connections, etc. shall be sealed.
- D. Duct Hangers: Rod and trapeze duct support shall be used for all ductwork with one dimension 18" or larger. Smaller duct may be installed with strap hanger system using SMACNA Standard as minimum.
  - 1. Hanger Rod: ASTM A36; steel; threaded both ends, threaded one end, or continuously threaded, with steel angle trapeze and non-eccentric beam clamps.
  - 2. Hanger rods, angles trapeze sizing and spacing shall meet SMACNA standards, and local and state building codes for duct sizes being supported.
  - 3. Straps and hanger attachment system sizing, spacing, and installation shall meet SMANCA Standards, local and state building codes, etc. for duct size and supports.
  - 4. Duct hangers shall not be supported from metal deck. Furnish and install all support steel as required to suspend with beam clamps similar to Grinnell Fig. 260 from structural steel joists or beams.

### 2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed. Provide duct material, gages, reinforcing, and sealing for operating pressures not less than 6" w.c. on upstream side (higher pressure side) of variable air volume boxes. Return air duct, exhaust air duct and downstream side of variable air volume boxes (low pressure side) shall be constructed to not less than 2" w.c.
- B. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible, and engineer's written approval is obtained, rectangular elbows may be used, provided turning vanes are utilized. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- F. Duct Sealant
  - a. All ductwork including supply air, outside air, return air, exhaust air and relief air ductwork shall have joints sealed.
  - b. Ductwork designed at SMACNA 6" pressure shall meet SMACNA Class "A" seal requirements.
  - c. Ductwork designed at SMACNA 2" pressure shall meet SMACNA Class "C" seal requirements.

## 2.3 SINGLE WALL SPIRAL DUCT AND FITTINGS

### A. General

- 1. All round and/or flat oval spiral duct and fittings shall be manufactured by a company whose primary business is the manufacture of spiral duct and fittings and who has been in business for at least ten (10) years. All spiral duct and fittings shall be manufactured by the same firm and shall be as shown on the contract drawings.
- 2. All spiral duct and fittings shall be manufactured from G-60 galvanized steel meeting ASTM A924 and A653 requirements, with a prime coat finish.

### B. Construction

- 1. Branch connections shall be made with 90° conical and 45° straight taps as shown on the drawings. All branch connections shall be made as a separate fitting. Factory or field installation of taps to spiral duct shall not be allowed without written approval of the engineer. Manufacturer's published individual fitting performances shall be on file with the design engineer ten (10) days prior to bid.
- 2. All elbows shall be fabricated with a centerline radius of 1.5 times the diameter. 90° and 45° elbows in diameters 3" round through 10" round shall be stamped or pleated elbows. All other elbows shall be of the gored type, fabricated in accordance with the following:

| <u>DEGREE OF ELBOW</u> | <u>NUMBER OF GORES</u> |
|------------------------|------------------------|
| less than 36°          | 2                      |
| 37° thru 71°           | 3                      |
| 72° thru 90°           | 5                      |

Where it is necessary to use two-piece mitered elbows, they shall have a minimum number of vanes in accordance with the following:

| <u>DUCT DIAMETER</u> | <u>NUMBER OF VANES</u> |
|----------------------|------------------------|
| 3" thru 9"           | 2                      |
| 10" thru 20"         | 3                      |
| 21" and up           | 5                      |

3. Circumferential and longitudinal seams of all fittings shall be a continuous weld or spot welded and sealed with mastic. All welds shall be painted to prevent corrosion.
4. All field joints up to and including 60" shall be made with a 2" slip-fit or slip coupling. Diameters 62" round and larger shall be joined with 2"x2"x3/16" Vanstone flanges for fittings and solid welded flanges for spiral duct.
5. Proprietary connectors such as manufactured by Ductmate or AccuFlange may also be used in lieu of slip connections or angle flanges.
6. Access doors shall be supplied by the duct manufacturer at all fire and/or smoke dampers.
7. All flanges and access doors shall be factory installed. Shipments of loose flanges, access doors or taps for field installation into spiral duct will not be allowed.

C. Metal Gauges

1. Metal gauges for single wall round ducts shall be as follows:
  - a. Round ducts with maximum 2" W.G. positive static pressure:

| <u>DUCT DIAMETER</u> | <u>SPIRAL DUCT</u> | <u>FITTINGS AND LONGITUDINAL SEAM DUCT</u> |
|----------------------|--------------------|--|
| 3" thru 26"          | 26                 | 24   |
| 28" thru 36"         | 24                 | 22   |
| 38" thru 50"         | 22                 | 20   |
| 52" thru 60"         | 20                 | 18   |
| 62" thru 78"         | 18                 | 16   |

- b. Round ducts with maximum 2" W.G. negative static pressure:

| <u>DUCT DIAMETER</u> | <u>SPIRAL DUCT</u> | <u>FITTINGS AND LONGITUDINAL SEAM DUCT</u> |
|----------------------|--------------------|--|
| 3" thru 17"          | 26                 | 24   |
| 18" thru 20"         | 24                 | 22   |
| 21" thru 22"         | 24                 | 20   |
| 24" thru 26"         | 22                 | 20   |
| 28" thru 30"         | 22                 | 18   |

|              |    |                |
|--------------|----|----------------|
| 32" thru 34" | 20 | 18             |
| 36" thru 42" | 20 | 16             |
| 44" thru 48" | 20 | 18(note 1 & 3) |
| 50" thru 60" | 18 | 18(note 2 & 3) |

Notes:

1. Reinforce with 1"x1"x1/8" girth rings every 6 feet.
2. Reinforce with 1¼" x 1¼" x 3/16" girth rings every 4 ft.
3. When companion flange joints are used as reinforcement, 44" to 48" diameter shall be 2"x2"x3/16" and 50" to 60" diameter shall be 2½"x2½" x 3/16".

D. Manufacturers

1. All spiral duct fittings shall be as manufactured by SEMCO Incorporated or approved equal.

2.4 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
  1. Less Than 12 Inches Square: Secure with sash locks.
  2. Up to 18 Inches Square: Provide two hinges and two sash locks.
  3. Up to 24 x 48 Inches: Three hinges and two compression latches with outside and inside handles.
  4. Larger Sizes: Provide an additional hinge.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 EQUIPMENT FLEXIBLE DUCT CONNECTIONS (To air moving equipment.)

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed.
- B. Connector: Fabric crimped into metal edging strip.



1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inch wide 24 gage galvanized steel.

## 2.7 FLEXIBLE INSULATED DUCTS

- A. All flexible ducts used to connect diffuser, grilles, etc. shall be similar to Flexmaster USA, Inc.; Type #3. Flex duct shall be insulated type consisting of a factory fabricated assembly of a trilaminate of aluminum foil, fiberglass and polyester. It shall be mechanically locked without adhesive into a formed aluminum helix on the ducts outside surface and shall withstand a minimum 6" w.c. operating pressure. The duct material shall be factory wrapped in a thick blanket of fiberglass insulation with a "C" factor of .25 or less. The insulation shall be encased in a fire retardant polyethylene protective vapor barrier with a perm rating of not over 0.1 grains per square foot per hour per inch of mercury. The flexible duct shall be constructed in accordance with and be listed as UL 181 Class I air duct and comply with NFPA 90A and 90B and have a flame spread of not over 25 and a smoke developed of not over 50. The flexible duct shall have a minimum pressure rating of 12" w.c. through a temperature range of -20°F to 250°F. Flexible duct shall be UL rated.
- B. Maximum length of flexible duct shall be 5'-0" to each outlet unless indicated otherwise on drawing.
- C. Flexible duct shall be installed without bends unless so indicated on drawing.

## 2.8 DUCT SPIN-IN FITTINGS

- A. Low pressure spin-in fittings (take-offs from main duct to flexible duct) shall be similar to Flexmaster USA, Inc. Model CB-D conical bellmouth fitting with damper and positive locking wing nut. Edges of the take-off opening in the duct shall be sealed with fire retardant duct sealer.

## 2.9 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension, steel construction, with individually adjustable blades and mounting straps.

## 2.10 BACKDRAFT DAMPERS.

- A. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturers standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel 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.

## 2.11 FIRE, SMOKE AND COMBINATION FIRE/SMOKE DAMPERS

- A. Fire dampers shall be fabricated in accordance with NFPA 90A and UL 555. They shall have a minimum rating of 1½ hour, have a dynamic closure rating of 3,000 fpm and 6" wg

and be so identified with a UL label. Smoke dampers shall be fabricated in accordance with NFPA 90A and UL 555S with same rating as fire damper and be so identified with a UL label. Smoke damper shall be opposed blade type, normal functions to close automatically and opened by a factory installed electric actuator. A smoke damper may also be a fire damper if it's location lends itself to the multiple functions and it meets the requirements of both.

- B. Provide factory sleeve and collar for each damper.
- C. Operators: Factory installed UL listed and labeled spring closed motorized open, electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft.
- D. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro-thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- G. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro-thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- F. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side with locking clip.
- G. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- H. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream.
- I. Fusible Links: Listed for 165 degrees F unless higher or lower temperature rating is required. Contractor shall verify usages and ratings for fusible link temperature rating.

## 2.12 VOLUME CONTROL DAMPERS.

- A. Provide balancing dampers on all duct take-offs to diffusers, grilles and registers; at points on supply, return and exhaust systems where branches take off from larger ducts, as required for air balancing (install damper a minimum of 2 duct widths from take-off; as required by balancing agency; and where indicated on drawings. Where access to dampers cannot be achieved, access panels shall be installed. If access panels are not preferred, remote dampers shall be installed. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed. All dampers shall have a locking device per SMACNA Standards, to hold the damper in a fixed position without vibrating.
- B. Splitter Dampers:
  - 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum ¼ inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- F. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  3. Where rod lengths exceed 30 inches provide regulator at both ends.
- 2.13 ROOF CURBS
- A. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.
- 2.14 ROOF AIR INTAKE HOODS OR RELIEF AIR HOODS
- A. See schedules on drawings and furnish all.
- 2.15 EXHAUST FANS
- A. See schedules on drawings and furnish all.
- 2.16 DIFFUSERS AND GRILLES
- A. See schedules on drawings and furnish all.
- 2.17 LOUVERS
- A. See schedule on drawings and furnish all.

## PART 3 EXECUTION

### 3.1 DUCT INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed. Note: All ductwork joints, fittings, etc. shall be sealed.
- C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Provide openings in ductwork for pitot tube where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use crimp joints with bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect flexible ducts to metal ducts mechanically without adhesives. Connect outlets to low pressure ducts with flexible duct held in place with strap or clamp.
- I. Coordinate duct locations with available space, route ducts around obstructions as required, and review duct changes with Engineer, all before starting construction.
- J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- K. Install manual balancing dampers in ductwork at all branch take-offs, all diffuser and grille take offs, etc.
- L. Install roof exhaust fans on minimum 18" high roof curbs but not less than 12" higher than parapet walls within 10'-0" of fan.

### 3.2 DUCT CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

### 3.3 SMOKE AND FIRE DAMPER PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.4 FIRE DAMPER, ACCESS DOOR AND FLEXIBLE DUCT INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible for 6" pressure duct system as a minimum. Where requirements are specified in this specification, or noted on drawings above the minimum SMACNA Standards, the more stringent specified and noted requirements and practices shall be followed.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 12x12 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated unless limited by duct size.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges in accordance with NFPA 92A and the latest edition of "SMACNA State Fire Marshal, Fire and Smoke Damper Clarification" manual as published by SMACNA.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- I. Use splitter dampers only where indicated.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- K. Provide balancing dampers where recommended by balancing agency.

### 3.5 DIFFUSER AND GRILLE INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, grilles and registers, whether dampers are specified as part of the diffuser, grille or register assembly.

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- E. Paint ductwork visible behind air outlets and inlets matte black.
- F. Diffuser/grille color shall be selected from the full range of manufacturer available colors and finishes.

END OF SECTION

MAI: 2022-1558

SECTION 23 74 00

ROOFTOP HVAC UNIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rooftop HVAC unit and accessories.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ARI 210 - Unitary Air-Conditioning Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. NFPA 70 - National Electric Code
- D. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- E. ANSI/ASHRAE 90A - Energy Conservation in New Building Design
- F. ARI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.

1.3 QUALITY ASSURANCE

- A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on product offering.
- B. ISO 9001 Certification. The air handling manufacturer shall be ISO 9001 Certified by a third party registrar, such as HSB Registration Services, that is accredited by an accreditation body such as ANSI-RAB and / or RvC Dutch Council for Accreditation.
- C. Constant Volume Air Handling Units: Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430. If air handling units are not certified in accordance with ARI 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.
- D. Variable Air Volume Air Handling Units with Variable Inlet Vanes: Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430. Certify units with inlet vanes in wide-open position. If air handling units are not certified in accordance with ARI 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.
- E. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-91.

#### 1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

#### 1.5 ACOUSTICS

- A. Manufacturer of packaged rooftop equipment shall provide Noise Criteria (NC) sound level data across all octave band center frequencies for cataloged operating range of unit at gross cooling capacity range. Data shall be obtained in conformance with ANSI S1.32-1980, American National Standard Methods for the Determination of Sound Power Levels of Discrete Frequency and Narrow Band Noise Sources in Reverberation Rooms and per AMCA Standard 300-85 test code "Sound Rating Air Moving Devices".

#### 1.6 REGULATORY REQUIREMENTS

- A. Unit shall conform to ANSI/UL 465 for construction of packaged air conditioner and shall have U.L. label affixed to rooftop unit package. In the event the unit is not UL approved, the manufacturer shall, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform required modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.

#### 1.7 EXTRA MATERIALS

- A. Install new clean filters at end of project. Provide one extra set of filters for future use by Owner at completion of project.
- B. Furnish one extra complete set of fan motor drive belts.

#### 1.8 WARRANTY

- A. A parts warranty for one year from date of start-up or 18 months from date of shipment, whichever comes first, shall be provided at no additional cost.

### PART 2 PRODUCTS

#### 2.1 ROOFTOP RTU-\_\_\_ ( Trane Packaged Gas/Electric Convertible, 1½ - 5 ton)

##### A. General

1. All units shall be factory assembled, piped, internally wired and fully charged with R-410A. All units shall be designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities shall be rated in accordance with A.R.I. standards. The YCC-F heating/cooling unit design is certified by the American Gas Association (A.G.A.) or Canadian Standards Association C.S.A.) specifically for outdoor applications using propane or natural gas. All units shall be designed for outdoor rooftop or ground level installation. Exterior surfaces of all units shall be phosphatized, zinc-coated steel with epoxy resin primer and baked enamel finish. Shipped for horizontal application, convertible to downflow.



- B. Casing: All panels shall be 20 gauge steel, gasketed and insulated. Foil faced glass fiber insulation shall be in the heat exchanger section. Mat faced insulation shall be in the evaporator section. Base pan and mounting rails shall be 18 gauge.
- C. Controls: Refrigeration cycle controls shall include condenser fan, evaporator fan and compressor contactors. Compressor shall be equipped with a combination internal winding thermostat/current overload. Internal high pressure relief shall also be avoided.
- D. Refrigeration System
  - 1. Compressors - All units shall have hermetically sealed Climatuff™ compressors. Compressors shall be equipped with over temperature, over current and high pressure protection. Crankcase heaters shall be standard on all three phase models.
  - 2. Evaporator Coil - Internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins, factory pressure and leak tested at 250 to 300 psig.
  - 3. Condenser Coil - Outdoor coils shall be internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins. Each coil shall be factory pressure and leak tested at 420 psig.
  - 4. Indoor Air Fan - Direct drive, forward curved, centrifugal type. Motor shall have thermal overload protection. Permanently lubricated motor bearings. Motor/blower assembly isolated from unit with rubber mounts.
  - 5. Condenser Fan - Direct drive, draw thru propeller type. Weather proofed permanent split capacitor fan motor shall have built in thermal overload and permanently lubricated motor bearings.
  - 6. Low Ambient - Standard refrigerant system operation down to 55°F. Low ambient accessory required for operation in 0°F ambient condition.
- E. Heating System
  - 1. Gas Fired Heating Section - Models shall provide completely assembled, wired and piped gas fired heating systems within unit. Design certified by A.G.A. or C.S.A., specifically for outdoor application. Threaded gas connection on the unit.
  - 2. Electronic Ignition System - Main burner is lit each time thermostat calls for heat. Flame sensor proves flame and keeps the main burners on. Should a loss of flame occur, the main valve closes and the spark recurs within 0.8 second. When thermostat is satisfied, main burner is extinguished.
  - 3. Forced Combustion Blower - Insures flame stability under varying wind conditions. Gives higher combustion efficiency and location flexibility.
  - 4. Heat Exchanger - Aluminized steel tubes. Free floating design.
  - 5. Burners - 20 gauge aluminized steel. Multi-port inshot.
- F. Downflow Accessories

1. Roof Curb - The roof curb shall be designed to mate with the unit and provide support and complete weather-tight installation when properly installed. Curb shall ship knocked down for field assembly, and include wood nailer strips.
2. Fully Modulating Economizer - This accessory shall be field installed and be composed of the following items: 0-100% fresh air damper, damper drive motor, fixed dry bulb enthalpy control, and low voltage polarized plug for electrical connections. Solid state enthalpy or differential enthalpy control is optional. Economizer operations shall be controlled by the preset position of the enthalpy control. A barometric relief damper shall be standard with the economizer and provide a pressure operated damper that shall be gravity closing and prohibit entrance of outside air on equipment "off" cycle.
3. Manual Fresh Air Hood - Manual outside air provides a fixed outside air quantity from 0 to 25 percent. Includes hood and birdscreen.
4. Low Ambient Control - Control allows cycling of compressor under low ambient cooling conditions. Required for cooling operation to 0°F.

G. Field Installed Control Options.

1. Thermostats - Two stages heating/cooling or one stage heating/cooling thermostats are available in either manual or automatic changeover.
2. Programmable Electronic Night Setback Thermostat - Heating setback and cooling setup with 7-day, 5-1-1 programming capability. Available in 2 heating/cooling or 1 heating/cooling versions with automatic changeover.
3. Economizer Controls - The standard equipment offering is a fixed dry bulb changeover control. In addition to the standard offering, there are two other field installed control accessories.
4. Enthalpy Control - Replaces the dry bulb control with a solid state dry bulb and wet bulb changeover controller which has a fully adjustable set point. Enthalpy control offers a higher level of energy savings potential than the standard dry bulb control due to the additional wet bulb sensing capability.
5. Differential Enthalpy - Replaces the standard dry bulb control with two enthalpy sensors that compare total heat content of the indoor air and outdoor air to determine the most efficient entering air source. This control option offers the highest level of energy efficiency available.

H. ROOF CURB

1. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible

for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.

2.2 ROOFTOP RTU-\_\_\_\_ ( Trane Packaged Precedent 3 - 10 ton)

A. General

1. Units shall be convertible airflow. Operating range shall be between 115°F and 0°F cooling as standard from the factory for units with microprocessor controls. Operating range for units with electromechanical controls shall be between 115°F and 40°F. Cooling performance shall be rated in accordance with DOE and/or ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run-tested before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance with ANSI Z21.47 for gas fired central furnaces and UL 1995/CAN/CSA NO. 236-M90 for central cooling air conditioners. Canadian units shall be CSA certified.

B. Casing

1. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 1000 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing only a single fastener while providing a water and air tight seal. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil faced, fire retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with ½ inch, 1 pound density foil faced, closed cell material. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit.

C. Unit Top

1. The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and prevents water from pooling on unit top.

D. Filters

1. One inch, throwaway filters shall be standard on all 3-5 ton units. The filter rack can be converted to two inch capability. Two inch filters shall be factory supplied on all 6-10 ton units.
2. Filters installed at completion of project shall be new, clean, and free of construction dirt and dust.

3. Provide one additional set of filters to Owner at completion of the project. this filter set shall be used as a replacement set for future use by Owner.

E. Compressors

1. All 3 ton standard efficiency units shall have direct drive, hermetic, reciprocating type compressors. The reciprocating type compressors have a centrifugal oil pump providing positive lubrication to moving parts. Motor shall be suction gas cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Crankcase heater, internal temperature, and current sensitive motor overloads shall be included for maximum protection. The compressor shall have internal spring isolation and sound muffling to minimize vibration transmission and noise. Low pressure switches shall be standard.
2. 3 ton high efficiency, 4 and 10 ton standard and high efficiency units shall have direct drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas cooled and have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors.

F. Refrigerant Circuits

1. Each refrigerant circuit offers a choice of independent fixed orifice expansion device or thermal expansion valve. Service pressure ports, and refrigerant line filter driers shall be factory installed as standard. An area shall be provided for replacement suction line driers.

G. Evaporator and Condenser Coils

1. Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil and condenser coil shall be leak tested to 200 psig and pressure tested to 450 psig. The condensate coil shall have a patent pending 1+1+1 hybrid design with slight gaps for ease of cleaning. A removable, reversible, double sloped condensate drain pan is standard. Provision for through the base condensate drain is standard.

H. Gas Heating Section

1. The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and corrosion resistant steel throughout. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DSI) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Units shall be suitable for use with natural gas or propane (field installed kit) and also comply with the California requirement for low NOx emissions.

I. Outdoor Fans

1. The outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.

J. Indoor Fan

1. All 3 ton 3-phase units offer a choice of direct drive, FC, centrifugal fans or belt driven, FC centrifugal fans with adjustable motor sheaves. All 3-5 ton 1-phase units shall be direct drive motor only. All 6-10 ton units shall have belt drive motors. Units with belt drive motors shall have an adjustable idler arm assembly for quick adjustment to fan belts and motor sheaves. All motors shall be thermally protected. Direct drive oversized motors shall be available for high static operations. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).

K. Controls

1. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device.
2. A choice of micro-processor controls or electromechanical controls shall be available.
3. Microprocessor controls provide for all 24 volt control functions. With the microprocessor controls, the resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.
4. 24 volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.

L. Accessories/Options

1. Roof Curb - The roof curb shall be designed to mate with the unit's downflow supply and return openings and provide support and a watertight installation when installed properly. The roof curb design shall allow field fabricated rectangular supply/return ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curb shall be shipped knocked down for field assembly and shall include wood nailer strips.
2. Economizer - This accessory shall be either field or factory installed and is available with or without barometric relief. The assembly includes fully modulating 0-100 percent motor and dampers, minimum position setting, preset linkage, wiring harness with plug, and fixed dry bulb control. Optional solid state enthalpy and differential enthalpy control shall be either factory or field installed. The factory installed economizer arrives in the shipping position and shall be moved to the operating position by the installing contractor.

3. Remote Potentiometer - Field installed, the minimum position setting of economizer shall be adjusted with this accessory.
4. Motorized Outside Air Dampers - Factory or field installed manually set outdoor air dampers shall provide up to 50 percent outside air. Once set, outdoor air dampers shall open to set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
5. Manual Outside Air Damper - Factory or field installed rain hood and screen shall provide up to 50 percent outside air.
6. Oversized Motors - Factory or field installed direct drive oversized motors shall be available for high static applications.
7. Powered Exhaust - The field installed powered exhaust, available for 6-10 ton units, shall provide exhaust of return air, when using an economizer, to maintain better building pressurization.
8. Discharge Air Sensing - This factory or field option provides true discharge air sensing in heating models. This sensor is a status indicator readable through Tracer® or Tracker®. This option is available for microprocessor controlled units.
9. Coil Guards - Hail protection quality coil guards shall be either factory or field installed for condenser coil protection.
10. Through the Base Electrical Access - An electrical service entrance shall be factory provided allowing electrical access for both control and main power connections inside the curb and through the base of the unit. Option will allow for field installation of liquid tight conduit and an external field installed disconnect switch.
11. Through the Base Electrical with Disconnect Switch - Factory installed 3 pole, molded case disconnect switch with provisions for through the base electrical connections are available. The disconnect switch will be installed in the unit in a water tight enclosure with access through a swinging door. Factory wiring will be provided from the switch to the unit high voltage terminal block. The switch will be UL/CSA agency recognized. Note: the disconnect switch will be sized per NEC and UL guidelines but will not be used in place of unit overcurrent protection.
12. Through the Base Electrical with Circuit Breaker - This option is a factory installed thermal magnetic, molded case, HACR Circuit Breaker with provisions for through the base electrical connections. The circuit breaker will be installed in a water tight enclosure in the unit with access through a swinging door. Factory wiring will be provided from a switch to the unit high voltage terminal block. The circuit breaker will provide overcurrent protection, be sized per NEC and UL guidelines, and be agency recognized by UL/CSA.
13. Powered or Unpowered Convenience Outlet - This factory installed option is a GFCI, 120V/15 amp, 2 plug, convenience outlet, either powered or unpowered. When the convenience outlet is powered, a service receptacle disconnect will be available. The convenience outlet is powered from the line side of the disconnect or circuit breaker, and therefore will not be affected by the position of the disconnect or

circuit breaker. This option can only be ordered when the Though the Base Electrical with either the Disconnect Switch, or Circuit Breaker option is ordered.

14. Through the Base Gas Piping - The unit shall include a standard through the base gas provision. This factory installed option shall have all piping necessary including a pre-assembled, black steel, manual gas shut-off valve shall include a 1/8" NPT pressure tap. This assembly will require minor field labor to install.
15. Fan Failure/Clogged Filter Switches - These factory or field-installed options allow for individual fan failure and dirty filter indication in microprocessor controlled units. The fan failure switch will disable all unit functions and "flash" the Service LED on the zone sensor. The dirty filter switch will light the Service LED on the zone sensor and will allow continued unit operation.
16. Reference or Comparative Enthalpy - Reference or Comparative Enthalpy option shall be available when a factory installed downflow economizer is ordered. This option is available for micro controlled units.
17. High Pressure Cutout - This factory installed option is offered for units that do not have high pressure cutout as standard. All 3-phase models with scroll compressors include high pressure cutout as standard.
18. Hinged Access Doors - Sheet metal hinges are available factory installed on the filter/evaporator access door, indoor fan/heat exchanger door, and the compressor/control access door.
19. Supply and/or Return Air Smoke Detector - With this option installed, if smoke is detected, all unit operation will be shut down. Reset will be manual at the unit. Return air smoke detectors require minimum allowable airflow when used with certain models. See the Installation, Operation, and Maintenance (IOM) manual for the models affected and the minimum allowable airflow required. This option is available for micro controlled units.
20. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.

M. Control Options

1. COMM3/4 Communication Interface - This factory or field installed option shall be provided to interface microprocessor controlled units with the Trane Integrated Comfort™ systems.

2. Comm-5 LonTalk Communication Interface - This factory or field installed option shall be provided to allow the unit to communicate as a Trane Comm-5 device or directly with generic LonTalk Network Building Automation System Controls.
3. Zone Sensor - Field installed, this accessory shall be provided to interface with the Micro equipped units and shall be available in either manual, automatic programmable with night setback, with system malfunction lights or remote sensor options.
4. Thermostats - Two stage heating and cooling operation or one stage heating and cooling shall be available, for field installation, in either manual or automatic changeover. Automatic programmable electronic with night set back shall also be available.
5. Novar Unit Controls - Optional Novar rooftop unit controls shall be factory installed and tested. The Novar electronic thermostat module will interface with the unit microprocessor and will control the unit to the desired stage of cooling or heating.
6. Novar Return Air Sensor - This option, when used in conjunction with Novar Controls, will contain a factory provided and wired zone temperature sensor located in the return air stream.
7. Enthalpy Control - Replaces the dry bulb control with a wet bulb changeover controller which has a fully adjustable setpoint. Enthalpy control offers a higher level of comfort control, along with energy savings potential, then the standard dry bulb control. This is due to the additional wet bulb sensing capability. This option shall be available for microprocessor controlled units. It can be field installed or factory installed with the factory installed economizer.
8. Differential Enthalpy - Replaces standard dry bulb control with two enthalpy sensors that compare total heat content of the indoor air and outdoor air to determine the most efficient air source. This control option offers the highest level of comfort control, plus energy efficiency, available. This option shall be available for microprocessor controlled units. It can be field installed or factory installed with the factory installed economizer.
9. Low Ambient Cooling - All microprocessor units shall have cooling capabilities down to 0°F as standard. Electromechanical models have cooling capabilities to 40°F as built, or to 0°F by adding the optional low ambient (froststat) control.
10. Thermal Expansion Valve - All units shall have a short orifice refrigerate control metering device. For more exact refrigerant flow, when using unit in low airflow applications, a Thermal Expansion Valve option shall be available.

## 2.3 ROOFTOP H.V.A.C. UNIT (Trane packaged Voyager 6 1/4 thru 25 tons)

### A. General

1. Units shall be dedicated downflow or horizontal airflow. Operating range shall be between 115°F and 0°F cooling as standard from the factory for all units. Cooling performance shall be rated in accordance with DOE and/or ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A and



100 percent run-tested before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance to ANSI Z21.47 for gas fired central furnaces and UL 1995/CAN/CSA No. 236-M90 for central cooling air conditioners.

B. Casing

1. Unit casing shall be constructed of zinc coated, heavy gauge galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing only a single fastener on the 3-7½ ton units and not more than three screws on the 8½-25 ton units while providing a water and air tight seal. The downflow unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/2" high supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting.

C. Unit Top

1. The top cover shall be one piece or where seams exist, it shall be double hemmed and gasket sealed to prevent water leakage.

D. Filters

1. Filters shall be of the throwaway type and shall have two inch thick fiberglass media contained in a rigid frame. Filters shall have a rigid supporting maze across both the entering and leaving faces of the media.
2. Filters installed at completion of project shall be new, clean, and free of construction dirt and dust.
3. Provide one additional set of filters to Owner at completion of the project. this filter set shall be used as a replacement set for future use by Owner.
4. Filters shall be rated UL class 2.

E. Compressors

1. All 6¼ -17½ ton standard and 6¼ - 10 ton high efficiency units shall be direct-drive hermetic reciprocating type compressor(s) with centrifugal oil pump providing positive lubrication to moving parts. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Crankcase heater, internal temperature and current-sensitive motor overloads shall be included for maximum protection. Shall have internal spring isolation and sound muffling to minimize vibration transmission and noise. External high pressure cutout shall be provide on 15 and 17½ ton models. Low pressure switches shall be standard.

8½, 12½ and 17½ ton high efficiency units and all 20 and 25 ton units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps.

F. Refrigerant Circuits

1. Each refrigerant circuit shall have independent fixed orifice expansion devices, service pressure ports and refrigerant line filter dryers factory installed as standard. an area shall be provided for replacement suction line dryers.

G. Evaporator and Condenser Coils

1. Internally finned 3/8" copper tubes mechanically bonded to configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil and condenser coil shall be leak tested to 200 psig and pressure tested to 450 psig.

H. Gas Heating Section

1. The heating section shall have a drum and tube heat exchanger design using corrosion resistant steel components. A forced combustion blower shall supply premixed fuel to a single burner ignited by a pilotless hot surface ignition system. In order to provide reliable operation, a negative pressure gas valve shall be used that requires blower operation to initiate gas flow. On an initial call for heat, the combustion blower shall purge the heat exchanger 45 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat. Units shall be suitable for use with natural gas or propane (field installed kit) and also comply with California requirements for low NOx emissions.
2. The 6¼ and 7½ ton units shall have either single or two stage heating options and the 8½ through 25 ton units shall have two stage heating.

I. Outdoor Fans

1. The outdoor fans shall be direct-drive statically and dynamically balanced, draw through in the vertical discharge position. The fan motor(s) shall be permanently lubricated and have built-in thermal overload protection.

J. Indoor Fan

1. Units shall have belt driven FC centrifugal fans with adjustable motor sheaves. Units over 7½ tons shall have an adjustable idler-arm assembly for quick-adjustment to fan belts and motor sheaves. All motors shall be thermally protected. Oversized motors shall be available for high static operations.

K. Controls

1. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide external location for mounting fused disconnect device. Micro-processor controls shall be provided for all 24 volt control functions. The resident control algorithms shall make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from setpoint and provides better building comfort. A centralized Micro-processor shall provide anti-short cycle

timing and time delay between compressors to provide a higher level of machine protection.

L. Roof Curb

1. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.

M. Economizer

1. For downflow units - Economizer shall be either field or factory installed. The assembly includes - fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting, preset linkage, wiring harness with plug and fixed dry bulb control. Solid state enthalpy and differential enthalpy control shall be a factory supplied, field installed accessory. The factory-installed economizer arrives in the shipping position and shall be moved to the operating position by the installing contractor.

N. Economizer

1. For horizontal units - Economizers shall be field-installed only. The horizontal economizer shall contain the same features as the downflow economizer with the exception of barometric relief.

O. Remote Potentiometer

1. The minimum position setting of economizer shall be adjusted with this accessory.

P. Powered Exhaust

1. The powered exhaust for 6¼ - 25 ton downflow units shall assist the barometric relief damper in the economizer in relieving building pressurization.

Q. Motorized Outside Air Dampers

1. Manually set outdoor air dampers shall provide up to 50 percent outside air. Once set, outdoor air dampers shall open to set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down. This option shall be available for the 6¼-25 ton models.

R. Oversized Motors

1. Furnish factory installed oversized motors for high static applications.

S. Zone Sensors

1. Shall be provided to interface with the Micro equipped Voyagers and shall be available in either manual, automatic programmable with night setback, with system malfunction lights or remote sensor options.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure. Install roof mounting curb level.

3.3 MANUFACTURER'S FIELD SERVICES & WARRANTY

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit.
- B. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.
- C. Furnish complete service and maintenance of units for one year from date of substantial completion.
- D. Furnish initial start-up and shut-down during first year of operation, including routine servicing and check-out. Furnish Owner's personnel training on operation and maintenance of rooftop unit.
- E. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.
- F. Submit copy of service call work order on report to the Owner, and include description of work performed.
- G. The Sheetmetal Trade shall be responsible for installation and wiring of all rooftop unit manufacturer furnished accessories such as the economizer, power exhaust fan, roof curb, etc. The Sheetmetal Trade shall verify all work required during bidding and include all costs in their bid.

END OF SECTION

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SECTION 23 82 00

LIQUID HEAT TRANSFER EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Baseboard radiation.
- B. Finned tube radiation.
- C. Unit heaters.
- D. Cabinet unit heaters
- E. Variable air volume box with hot water heating coil.

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment.

PART 2 PRODUCTS

2.1 BASEBOARD RADIATION

- A. Heating Elements:  $\frac{3}{4}$  inch ID copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins, one tube end belled.
- B. Enclosure: Minimum 22 gage steel with 7 inch high back and top of one piece; front panel, end panel, end caps, corners and jointer pieces to snap together, with front panel easily removable. Provide full length damper.
- C. Finish: Factory applied baked enamel of color as selected by Architect/Engineer on visible surfaces of enclosure or cabinet.
- D. Element Brackets: 18 gage galvanized steel to support from panel and noise free element cradle.
- E. Capacity: Based on 65 degree F entering air temperature, 180 degree F average water temperature or one psig steam. See schedules on drawings.

2.2 FINNED TUBE RADIATION

- A. Heating Elements:  $1\frac{1}{4}$  inch ID seamless copper tubing, 0.042 inches minimum wall thickness, mechanically expanded into evenly spaced aluminum fins, suitable for soldered fittings.
- B. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- C. Enclosures: 14 gage steel. Provide easily jointed components for wall to wall installation. Support rigidly, on wall or floor mounted brackets.
- D. Finish: Factory applied baked enamel of color as selected by Architect/Engineer on visible surfaces of enclosure or cabinet.

- E. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.
- F. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 x 7 inch minimum size, integral with cabinet.
- G. See schedule on drawings.

## 2.3 UNIT HEATERS

- A. Coils: Seamless copper tubing, 0.025 inch minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- B. Casing: 18 gage steel with threaded pipe connections for hanger rods.
- C. Finish: Factory apply baked primer coat enamel of color as selected by Architect/Engineer on visible surfaces of enclosure or cabinet.
- D. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- E. Air Outlet: Adjustable pattern diffuser on projection models and four way louvers on horizontal throw models.
- F. Control: Disconnect switch.
- G. See schedules on drawings.

## 2.4 CABINET UNIT HEATERS

- A. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi and 200 degrees F.
- B. Cabinet: 16 gage steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, and integral air outlet and inlet grilles.
- C. Finish: Factory applied baked enamel of color as selected by Architect/Engineer on visible surfaces of enclosure or cabinet.
- D. Fans: Centrifugal forward-curved double width wheels, statically and dynamically balanced, direct driven.
- E. Motor: Sleeve bearings, resiliently mounted.
- F. Control: Multiple speed switch, factory wired, located in cabinet.
- G. Filter: Easily removed one inch thick glass fiber throw-away type, located to filter air before coil.
- H. Mixing Dampers: Where indicated, mixing sections with dampers.

- I. See schedules and drawings.
- 2.5 VARIABLE AIR VOLUME BOXES WITH HOT WATER HEATING COIL
  - A. Manufacturers - Trane, Titus or Price.
  - B. Casing - 22 gauge galvanized steel.
  - C. Insulation - The interior surface of the unit casing is acoustically and thermally lined with a 1-inch, 1.55 lb/cubic foot density glass fiber with high density facing. The insulation R-value is 3.8. The insulation is UL listed and meets NFPA-90A and UL 181 standards. The insulation is covered by an interior liner made of 26-gauge galvanized steel. All wire penetrations are covered by grommets. There are no exposed edges of insulation (complete metal encapsulation).
  - D. Primary Air Valve - The primary air inlet connection is an 18-gauge galvanized steel cylinder sized to fit standard round duct. A multiple point, averaging flow sensing ring is provided with balancing taps for measuring airflow. An airflow versus pressure differential calibration chart is provided. The damper blade is constructed of a closed-cell foam seal that is mechanically locked between two 22-gauge galvanized steel disks. The damper blade assembly is connected to a cast zinc shaft supported by self-lubricating bearings. The shaft is cast with a damper position indicator. The valve assembly includes a mechanical stop to prevent over stroking. The maximum leak rate is 1% at 4 in. w.g. inlet static pressure.

\*\*\*\*\*OR\*\*\*\*

- D. Primary Air Valve: Nominal sizes 300, 600, 1100, 1700, 2400, 3200, and 4200 CFM on all unit types. The Trane air valve is a cylindrical flow control device with an integral electric actuator. Valve inlet is die cast aluminum and tapered to fit standard round ductwork. Maximum leak rate is 1 percent at 4 inches wg. inlet static pressure. Integral multiple point, averaging flow sensing ring to provide primary air flow measurement within  $\pm 5$  percent of unit rated airflow with 1 1/2 diameters of straight duct upstream of unit. Integral flow taps and calibration chart provided on each unit.
- E. Access Panel - Furnish an access panel in the bottom of the unit to provide access to the air valve.
- F. Outlet Connection - Straight flange, flanged, slip and drive, or integral outlet - Sheet metal connection at unit discharge to facilitate ductwork installation. Straight flange outlet connection.
- G. Agency Listing - All units are UL Listed and CSA approved.
- H. Hot Water Coil - Standard and high capacity hot water coils are factory mounted. Full fin collars provided for accurate fin spacing and maximum fin-tube contact. 3/8 inches O.D. seamless copper tubes mechanically expanded into the fin collars. Coils are leak tested at 300 psig air pressure under water. Female sweat-type water connections provided. Available as right or left hand connections with all coils having same end water connections.

- I. Monitoring - VAV boxes shall be monitored and controlled by the B.A.S. control system. CFM readings shall be monitored and changed through the B.A.S. control system.
- J. Each VAV box shall have a flow sensor/ring to allow reading of cfm through the B.A.S.
- K. The volume box shall be selected with a maximum air pressure drop of 0.4" w.c. No volume boxes with a higher APD of greater than 0.4" will be accepted.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Beginning of installation means installer accepts existing surfaces.

#### 3.2 INSTALLATION

- A. Install all equipment and accessories in accordance with manufacturer's instructions.
- B. Locate baseboard radiation on outside walls and run cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install end caps where units butt against walls.
- C. Locate finned tube radiation on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Align cabinet joints with window mullions. Install wall angles where units butt against walls.
- D. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Install cabinet unit heaters, fan-coil units as indicated. Coordinate to assure correct recess size for recessed units.
- F. Protect units with protective covers during balance of construction.
- G. Provide hydronic units with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

END OF SECTION

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SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Basic electrical Requirements specifically applicable to Division 26, 27 & 28 Sections, in addition to Division 1 - General Requirements.
- B. Information in this section is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions and Division 1 of these specifications. Any conflict between Division 26, 27 & 28 and those in the General Conditions or within the Division 26 drawings, Supplementary Conditions and Division 1 shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.
- C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor materials, equipment and incidentals necessary for complete installation and operation.
- D. All information contained in this section applies to all sections within Division 26 as it was part of each section.
- E. Final walk-thru. Electrical Contractor shall submit in writing to the Architect's office or the Construction Manager advising that all of the Division 26, 27 & 28 work has been completed in accordance with the plans and specifications. The intent is to acknowledge the Contractor is ready for a walk-thru. Open items that are part of the required construction work should be completed prior to the final walk-thru to avoid developing a so called construction completion list. The engineer reserves the right to reschedule the final walk-thru as determined accordingly.
- F. Pre-bid questions. All pre-bid questions, clarifications, etc. must be submitted in writing to the Architect Office or the Construction Manager. All phone calls, faxes or e-mails from bidders and manufacturers, etc. directly received by the Engineers office during the bidding phase will be deferred back to the Architect Office or the Construction Manager.
- G. Electrical Contractor shall review all of the project plans and specifications and not rely solely on the electrical drawings to establish a project bid. Refer to the structural and mechanical drawings for final mechanical equipment locations. Mechanical drawings shall govern over the electrical drawing locations.
- H. Unit Pricing: Contractor shall furnish pricing as listed in the Bid Proposal Forms.

- I. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

## 1.2 LAYOUT OF THE WORK

- A. Examine the site and all the drawings before proceeding with the layout and installation of this work. Verify all door swings and clearances to cabinets, etc., before locating switch and outlet boxes. Locate conduit, boxes, etc., essentially as shown on the drawings but in exact layout determined on the job to suit actual conditions. Confer and cooperate with the other trades on the job so all parts will be installed in proper relationship. Precise locations of parts to coordinate with other work is the responsibility of the Contractor.
- B. The Electrical Trades shall complete all cutting and patching for the electrical work, unless noted or specified otherwise. Division 26, 27 & 28 Contractor shall be responsible to coordinate with the site Restoration Contractor for the new underground electrical work.
- C. Arrange exposed work as closely as practicable to wall or ceiling surfaces in an accurate alignment. Locate concealed work so fittings, connectors and other projections will clear surfaces. Exposed work is defined as non-finished spaces, such as mechanical / electrical rooms or as indicated on architectural room schedules. All finished spaces, installation shall be concealed. Refer to Architectural drawing for room finish schedules.
- D. During the bidding phase, if any design or discrepancy issues are discovered between the electrical drawings, specifications and other project plans, the contractor shall notify the Architect/Engineer. The intent is to resolve any issues during the bidding phase. For pertinent issues, addendums will be issued accordingly. After entering into a contract, it shall be considered there are no identified conflicts.
- E. No drilling of existing laminated beams for new work is permitted without review with the project Structural Engineer

## 1.3 INTERFERENCES

- A. The Electrical Contractor shall examine the plans of mechanical trades, the architectural and structural drawings and shall notify the Architect/ Engineer to resolve such interference or discrepancy. The Electrical Contractor bid shall not be based solely on the Electrical Plans and Specifications. Contractor shall obtain and review all project documents. The Contractor, when directed, shall make such changes or off-sets as required so that the work shall be properly located and coordinated with the other trades. Failure to comply with the foregoing will not relieve contractor's responsibilities of making such changes. Such changes shall be completed at no additional cost to the Owner.

- B. All changes in location of equipment, fixtures, distribution equipment, receptacles, etc., from those shown on plans, shall be made without charge when directed by the Architect/Engineer before installation. At this time, an agreement shall be made if such a change is an additional cost to the owner.
- C. The Electrical Contractor shall confer with other trades regarding location and size of pipes, equipment, fixtures, conduit, duct openings, switches, outlets, etc., in order that there may be no interference in the installation of the work of any trades or delay in the progress of any work.
- D. The Electrical Contractor shall be responsible for confirming final receptacle, data, and switch heights at countertop and casework locations with the architectural details. Architectural details shall govern final locations and mounting heights. Failure to coordinate will not relieve the contractor of making changes as required, at no cost to the owner.
- E. Any changes made, necessary through failure to make proper arrangement to avoid interference, shall not be considered as extra.
- F. The Electrical Contractor shall cooperate with those performing work under other divisions in his preparation of interference drawings, to the extent that the location of plumbing piping, heating piping, and/or ventilation ducts, with respect to the installation of other trades, shall be mutually agreed on by those performing work under other divisions.
- G. In the event the described work on the drawings doesn't match requirements described in the specification, the more stringent shall be provided.
- H. Electrical Contractor shall review the Architectural drawings for work station, casework details and section drawings that show raceway details. Furnish the raceway as noted and detailed.
- I. Contractor shall carefully review the code sections pertaining to safe working clearances to avoid piping, ducts interferences and other equipment. Install the electrical equipment to meet Code requirements. Adjust the locations shown as required.

#### 1.4 TRENCHING AND RELATED UNDERGROUND WORK

- A. The Electrical Contractor shall contact "811" 72 hours prior to any excavation to locate existing underground utilities. Pay all costs to obtain the services of a specialty utility service company to locate all private utilities as required.
- B. Prior to any actual trenching, Electrical Contractor shall review the utility maps; shall visually observe and review the intended routing for above and below ground obstruction; shall confer with the appointed field representative, and shall establish preliminary location for trenching.
- C. After this routing is established, Contractor shall hand dig in areas of obstructions where powered equipment is non-accessible.

## 1.5 MATERIALS AND WORKMANSHIP

- A. All materials and equipment furnished for installation on this project shall be new and in strict accordance with this specification. All packaged materials shall be delivered in the original containers which show the manufacturer's name and the identifying designations as to size, quality, etc. Materials delivered to the job in unmarked or mutilated packages will be immediately inspected by the Contractor. Materials or equipment judged as "damaged" by the Contractor's own inspection shall be immediately addressed with the supplier. All electrical equipment shall bear the Underwriter's Label.
- B. All work shall be performed in a professional manner under the supervision of the electrical project manager. The project manager shall be considered the main point of contact for the Architect/Owner's daily communication.
- C. Should any dispute arise as to the quality or fitness of the materials or workmanship, Architect, Owner, Engineer and Electrical Contractor shall mutually agree work is non-acceptable and shall be reworked at no additional cost to the Owner.
- D. Division 26, 27 & 28 equipment schedule descriptions shall govern if it is found that the manufacturer's catalog numbering shown on the drawing is not current, or changed by the manufacturer without notification. Division 26, 27 & 28 Contractor shall notify the Architect/Engineer with any conflicts during the bidding phase to get clarifications. After entering into a Contract, it shall be considered the equipment schedules provide the information to meet the intended specifications for quality and performance.

## 1.6 GUARANTEES

- A. All equipment and work performed under Division 26, 27 & 28 shall be guaranteed for one (1) year from time of substantial completion of project, unless directed otherwise in Division 1.

## 1.7 VOLUNTARY ALTERNATES

- A. The Architect/Engineer will only accept voluntary alternate as a bid deduct. Alternate must maintain the same level of quality to meet the design intent. Voluntary alternates must be submitted with the bid for review by the Owner. Failure to comply will be no reason to accept any voluntary alternates after entering into a contract.

## 1.8 OWNERS ACCEPTANCE OF EQUIPMENT

- A. Refer to Division 1.
- B. Upon the Owner's written acceptance, the Electrical Contractor's guarantee period shall begin and the Owner shall accept the responsibility for operation and maintenance and the Contractor's liability shall be limited to the conditions covered in the guarantee as described in these specifications.

## 1.9 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 Electrical Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

## 1.10 SUBMITTALS

- A. Submit electronic shop drawing files.
- B. Proposed Products List: Include Products specified in the following Sections:
  - 1. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables
  - 2. Section 26 05 36 - Cable Trays for Electrical Systems
  - 3. Section 26 09 23 - Lighting Control Devices
  - 4. Section 26 24 16 - Panelboards
  - 5. Section 26 27 26 - Wiring Devices
  - 6. Section 26 28 16 - Enclosed Switches and Circuit Breakers
  - 7. Section 26 29 13 - Enclosed Controllers
  - 8. Section 26 51 00 - Interior Lighting
  - 9. Section 26 56 00 - Exterior Lighting
  - 10. Section 28 46 13 - Fire Alarm System
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in single submittals.
- D. Mark dimensions and values in units to match those specified.
- E. Shop drawings shall be reviewed and checked by the Electrical Contractor for specification compliance prior to release for the Engineer's review. Failure to comply will be no cause or reason for additional costs to the Owner with project delays.
- F. Electrical distribution submittal shall include cut sheets for each piece of equipment. Written description is not acceptable.
- G. Bill of materials shall be submitted as part of O&M Manual. Bill of Materials is not considered a shop drawing.

## 1.11 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- C. Equipment: U.L. tested and approved for its purpose.
- D. The Electrical Contractor shall obtain and pay for all permits and inspection fees. Provide the Owner with final inspection documents from authorities having jurisdiction.

- E. State of Michigan, Bureau of Fire Services for Emergency Lighting and Fire Alarm Plan Review.
- F. Equipment: Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- G. Life Safety NFPA 101 – The State of Michigan current adopted edition.
- H. Fire Alarm Code NFPA 72 – The State of Michigan current adopted edition.
- I. 2015 Michigan Energy Code.
- J. ASHRAE 90.1 2013 Edition.
- K. 2019 School Rules.

#### 1.12 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on drawings, unless prevented by project conditions.
- B. All bidders shall personally inspect the site and acquaint themselves with all existing conditions involved in execution of this contract, and make all necessary measurements. No “extra” will be considered for additional work required because of bidder’s failure to do so.
- C. Arc flash warning labels. Provide arc flash generic warning labels in accordance with 2017 NEC Section 110 requirements.

#### 1.13 TEMPORARY SERVICES

- A. Division 26 Trades shall provide and maintain wiring for all interior construction lighting and power to meet OSHA Standards. Division 26 Trade shall provide and maintain all required lamps and guards. Contractor’s power tools, cords, etc shall be in strict accordance with National Electrical Code 2017, Article 590.
- B. Electrical Contractor shall pay for all temporary internet and power for their office and or construction trailer.
- C. Electrical Contractor shall be responsible to review Division 1 requirements to provide project temporary lighting and power requirements for the construction and demolition phases.

#### 1.14 RECORD DRAWINGS

- A. The Electrical Contractor shall furnish as-constructed drawings, including all Addendums, Bulletins and associated Field Directed Changes included as part of the record drawings.

#### 1.15 OPERATION AND MAINTENANCE MANUALS

- A. Verbal instruction and written operational instructions are to be given on all equipment and systems under this contract. A time is to be scheduled with the Architect/Engineer and Owner for these instructions and a time submitted in writing for instructions at the facility.
- B. Two (2) bound sets of Operating and Maintenance Manuals are to be submitted to the Architect/Engineer for approval. Manuals are to include complete parts list and maintenance procedures as well as operating instructions on all equipment supplied under Division 26, 27 & 28.

END OF SECTION

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SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition per plans and specifications.
- B. Conduit supports.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Electrical Contractor shall examine the project documents and visit the site as they deem necessary prior to submitting a bid. Do not rely solely on the Electrical Plans for all demolition requirements. Review all Project Documents prior to submitting a bid.
- B. The demolition information is provided to assist with labor costs associated with the electrical systems removal. The Electrical Contractor shall be responsible to confirm all quantities and the information provided.
- C. Upon removal of the existing ceiling, the Electrical Trades shall immediately notify the construction manager, Architect and Engineer in writing regarding existing conduits scheduled to remain that are not properly supported. Conduit evaluation shall be conducted with the Owner, Architect and Engineer. Failure for the Electrical Trades to submit a written conduit support condition will obligate the trade to support the conduits to meet current Code methods at no additional cost to the Owner.

3.2 PREPARATION



- A. Confirm with the Architect's Office and/or Construction Manager Project Schedules and review the Architectural, Structural and Mechanical drawings prior to commencing demolition.

### 3.3 DEMOLITION

- A. As noted or shown on the demolition plans, remove the electrical distribution equipment, lighting, receptacles, switching, associated conduit, surface raceway, interior building cable TV distribution, voice and data from only each station side outlet back to the existing technology distribution frame. Remove the fire alarm system, 120 volt clocks, wiring, PA speakers and the PA front end unit as noted or shown or shown on the drawings. Remove surface mounted conduit, boxes, and non-metallic raceway, from the existing walls in offices, classrooms, etc. Use care during the demolition phase to avoid damage of any glazed block, tile or brick veneered walls. Electrical Contractors are responsible to confirm all quantities and information provided.
- B. Mechanical trades or BAS Contractor shall remove all associated temperature components, and associated conduit and wiring.
- C. As noted or shown on the demolition plans, remove all TV voice and data cables from each station side back to the distribution frames. Remove all cables, patch cords at the distribution frames. Remove all TV cables and outlets from each TV monitor back to the distribution frames.
- D. Electrical Trades shall remove all existing fire alarm devices and associated conduits and surface mounted raceways. Patch to match.
- E. Electrical Trades shall transport all of the electrical salvaged materials to the Owner and include all transportation costs.
- F. Electrical Trades shall remove all of the existing electrical branch panelboards as noted, scheduled and shown on the drawings and specifications. Confirm all outages with the Owner to starting the replacement work.
- G. As noted or shown on the demolition plans, remove all of the existing non-metallic type surface raceway or surface metal conduits noted or specified to be removed. Contractor shall also be responsible to review the architectural, structural and mechanical demolition drawings for associated electrical demolition work. Do not rely solely on the electrical drawings for bid submitted.
- H. Remove all unused conduits and wiring serving lighting and power being removed from the finished ceiling space. Remove all abandoned low voltage cables from accessible portions in accordance with NEC Sections 760.25(A), 640(A), 645.3(A), 725.3(B), 770.3(A), 800.3(C), 820.3(A) and 830.3(A). Include costs in bid to walk the ceiling spaces with the Construction Manager and the Owner for visual assessment of abandoned cables.
- I. The Owner shall be responsible for main incoming internet and voice service to the building.
- J. The Owner shall be responsible for main incoming cable TV service to the building.

- K. The Owner shall be responsible to remove computers, printers, and monitors.
- L. All wall mounted and desk mounted phones shall be removed by the Owner.
- M. As noted or shown on the demolition plans, remove all existing PA speaker and circuits back to the front end. Remove the PA unit front end. Removal shall include all associated conduit as well.
- N. The Owner shall remove the existing TV monitors, the existing ceiling projectors, and all phones. Electrical Trades shall remove the associated raceway, cables and power circuits.
- O. As noted or shown on the demolition drawings, remove the exterior light fixtures. Backbox in-fill shall be completed as part of the masonry upgrade unless noted otherwise. Reuse the existing fixture backbox as noted on the drawings. Remove flood light fixtures that are mounted on a pipe mast, supported on the roof. It shall be the roofing contractor's scope of work to repair the roof upon the support removal.
- P. As noted or shown on the demolition plans, remove all existing exterior electric bells as noted on the drawings. The existing backbox in-fill shall be completed as part of the masonry upgrade.
- Q. Electrical Contractors are responsible to confirm all demolition quantities. Make pre-bid site visit arrangements as deemed necessary.
- R. All security system removal and reinstallation shall be completed by the Owner.
- S. The Owner shall be responsible for the removal or repairing of any existing stand-alone gym public address unit system.

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Fire rated cables.
- C. Service entrance cable.
- D. MC cable
- E. Non-metallic "NM" sheath cable.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Routing shown on Drawings is approximate unless dimensioned. Field route as required to best suit Project Conditions.
- D. Where wire and cable routing is not shown, and only a load destination is shown, determine exact routing and lengths required.

1.5 COORDINATION

- A. Coordinate Work under provisions of Division 1.
- B. Determine required separation between cable and other work.

- C. Determine cable routing to avoid interference with other work.

## 1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type THW, THHN/THWN, XHHW-2.

### 2.2 MC CABLE

- A. Factory assembled multiple insulated conductors enclosed in armor of interlocking metal corrugated sheath.
- B. Provide all clips and supports.

### 2.3 NON-METALLIC SHEATH CABLE

- A. "NM" "Romex" cable is not acceptable for use on this project.

### 2.4 FIRE RATED CABLE

- A. RHH fire rated type.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Use stranded conductors for control circuits.

- C. Use conductor size not smaller than 12 AWG for power and lighting circuits.
- D. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.
- E. Pull all conductors into raceway at same time.
- F. Protect exposed cable from damage.
- G. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- H. Use suitable cable fittings and connectors.
- I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- J. Clean conductor surfaces before installing lugs and connectors.
- K. Splices are not permitted.
- L. All power wiring shall be installed in conduit. Low-voltage wiring shall utilize the channel trays-hooks or free-air method, or other cable management methods that meet industry standards as noted on the drawings. Conduit drops for fire alarm devices, card readers, power assisted doors, and voice/data outlets shall be required. Electrical Trades shall be responsible for coordinating with the low-voltage system and drawings for required raceway. Low voltage cables installed in accessible ceiling space need not to be in conduit. However, the cables must be properly secured to the ceiling structure. Low voltage cables install in open ceiling in finished spaces shall be installed in conduit or within the cable tray.
- M. Refer to Section 26 09 23 for Occupancy Sensors wiring.
- N. Refer to Section 27 13 00 for Communications backbone cabling.
- O. Refer to Section 28 31 00 for Fire Alarm wiring.
- P. If the Electrical Trades Contractor elects, at their option, to combine homerun circuits installed in a single conduit, the derating 2017 NEC 310.15(b) Table must be utilized for allowable conductor ampacity values. If the derating method is utilized, then furnish and install properly derated cables and properly sized conduits to meet Code. Electrical Trades Contractor shall be responsible to obtain inspection from the Electrical Inspector and pay all supplemental inspection and/or requested plan review fees.
- Q. Shared neutrals for lighting and power circuits are not permitted.
- R. MC cable shall only be acceptable as the final connection to light fixtures installed in accessible ceilings (6 feet or less) and for device to device connections within stud wall. MC cable shall not be used for homeruns or feeders.

### 3.3 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 26 05 53.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing to assure proper operation.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.
- D. Building foundation grounding.
- E. Earth ground resistance.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 PERFORMANCE REQUIREMENTS

- A. Resistance: Meet the NEC Code requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 ROD ELECTRODE

- A. Material: Copper-clad steel or copper-weld type.
- B. Diameter: as scheduled on the drawings.
- C. Length: as scheduled on the drawings.

### 2.2 MECHANICAL CONNECTORS

- A. As scheduled on the drawings.

### 2.3 EXOTHERMIC CONNECTIONS

- A. As scheduled on the drawings.

### 2.4 WIRE

- A. Material: As scheduled on the drawings.
- B. Foundation Electrodes: Size to meet NFPA 70 requirements.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify site soil conditions before driving rod electrodes.

### 3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Provide bonding to meet Regulatory Requirements.
- D. Provide supplemental and service entrance grounding in accordance with 2017 NEC Section 250. Refer to Table 250-66
- E. Equipment Grounding Conductor: Provide a separate grounding conductor for lighting and power circuits as noted or specified on the drawings.
- F. Bond the paralleled service entrance conduits in accordance with NEC 2017 Section 310.10 requirements.
- G. In the case of an isolation ground system, the metal raceway may be used as the equipment ground and an insulated grounding conductor as the isolated



ground. If PVC conduit is utilized, then two insulated grounding conductors shall be installed.

- H. Complete the grounding conductor to the building foundation rebar in accordance with 2017 NEC 250-52 (3) requirements.
- I. As shown and noted on the drawings, provide ground conductor from the new addition's foundation rebar back to the building's main distribution panel service ground bar. Provide minimum #6 grounding conductor from the main electric distribution equipment to the data racks.
- J. Bond the cable tray or wire mesh tray with a #6 bare copper ground along the entire length of the cable tray. Bond to the ground bar in the IDF data rooms.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

### 3.4 EARTH GROUND RESISTANCE

- A. Use a meter that is suitable to tests 3 and 4 pole fall of potential with and without stakes. The meter shall measure ground loop resistances using only clamps, one stake, or one clamp and stakes. The stake-less test method shall measure earth ground loop resistances for multi-grounded system using only current clamps.
- B. The meter shall be capable of reading out which stakes or clamps to connect for each test. The resistance measurement shall calculate at 55 hz. Meter shall include automatic frequency control to identify existing interferences.
- C. Basic ground resistance measurements as applicable:
  - 3 pole
  - 4 pole
  - Stake-less ground loop
  - 3 pole with current clamp
  - 4 pole with current clamp
- D. Measuring principle: current/voltage measurement methods for the resistance methods listed above.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Handhole base.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
  - 1. Concrete Structural Elements: Use expansion anchors.

2. Steel Structural Elements: Use beam clamps.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Attachments of electrical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points whenever possible. Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Electrical Trades are still responsible for design, layout, and fabrication and installation of electrical supports and support attachment methods. Electrical Trades shall submit attachment methods to the Structural Engineer for review.
- B. Install products in accordance with manufacturer's instructions.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members without permission from Architect/Engineer.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- J. No drilling of laminated wood beams without structural engineer review.
- K. Construct handhole stone base as detailed on the drawings.

END OF SECTION

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SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible non-metallic conduit.
- D. Electrical metallic tubing.
- E. Nonmetal conduit.
- F. Electrical nonmetallic tubing.
- G. Flexible nonmetallic conduit.
- H. Fittings and conduit bodies.
- I. Surface raceway assembly.
- J. MC Cable.
- K. Flexible metal conduit.
- L. HDPE conduit.
- M. Conduit water sealant.
- N. Conduit seals (foundation walls).

1.2 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.3 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work

covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

#### 1.4 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI C80.3 - Rigid Aluminum Conduit.
- D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- E. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

#### 1.5 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

#### 1.8 PROJECT CONDITIONS

- A. Verify routing and termination locations of conduit prior to rough-in.
- B. Conduit routing shown is diagrammatic, field route conduit to avoid interferences.

## 1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 CONDUIT REQUIREMENTS

- A. Minimum Size:  $\frac{3}{4}$  inch unless otherwise specified.
- B. Underground Installations:
  - 1. Use Schedule 40 PVC conduit for general underground installation.
  - 2. Use Schedule 80 PVC conduit for heavy traffic areas.
  - 3. Use direct burial seamless HDPE as noted and shown on the drawings for underground installation.
- C. Outdoor Locations, Above Grade: Use rigid steel conduit.
- D. Wet and Damp Locations: Use rigid conduit or liquid-tight non-metallic flexible conduit.
- E. Dry Locations:
  - 1. Concealed: Use electrical metallic tubing.
  - 2. Exposed: Use electrical metallic tubing.
  - 3. Use minimum  $\frac{3}{4}$ " conduit for fire alarm drops.
  - 4. Use flexible metal conduit for final wiring connections to motors, VFD units, light fixtures in accessible ceiling and interior transformers.
  - 5. Use minimum 1" conduit for voice/data wiring.
  - 6. Use minimum 1  $\frac{1}{4}$ " conduit for ceiling projectors and HDMI location.

### 2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Fittings and Conduit Bodies: ANSI C80.5.
- C. Intermediate Metal Conduit (IMC): Rigid Steel.
- D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

### 2.3 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction.
- B. Fittings: ANSI/NEMA FB 1.

## 2.4 LIQUID-TIGHT NON-METALLIC FLEXIBLE METAL CONDUIT

- A. Description: Type NM. Manufacturer with a spiral of rigid PVC embedded reinforcement with a flexible PVC wall.
- B. Compatible fittings.
- C. Use for wet or exterior location as final wiring connections to motors or electrical equipment, etc.

## 2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; set screw type.

## 2.6 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

## 2.7 SURFACE RACEWAY ASSEMBLY

- A. One steel raceway as scheduled or noted on the drawings.
- B. Divided non-metallic raceway basic components
  - 1. Base cover
  - 2. Flat elbow
  - 3. Divided entrance fitting
  - 4. Blank end fitting
  - 5. Dividers
  - 6. Fill-in covers
  - 7. 2 gang horizontal device bracket

## 2.8 MC CABLE

- A. Corrugated steel tubing with integral conductors.
- B. Use MC cable as noted on the drawings and specified in Building Wire and Cable Specification 26 05 19.
- C. MC cable is not permitted for homeruns or feeders or branch device drops.

## 2.9 HDPE CONDUIT

- A. Smooth seamless for direct burial application.
- B. PVC cement is not acceptable for HDPE to PVC connection. Acceptable conduit adhesive shall be "Bonduit" offered by Polywater or approved equal.

- C. Use HDPE conduit couplers for transition to interduct, PVC or threaded steel conduit. Provide "E-loc" or electrofusion coupler type manufactured by Lamson Pipe Company or approved equal by Shur-Lock couplers by Arnco Corporation.
- D. Refer to NEC 2017 Section 353 for the HDPE conduit connection and installation methods.
- E. HDPE conduit is not acceptable for exposed installations.

## 2.10 WATER SEALANT

- A. Use "Polywater FST" for a means and methods to seal leaking conduits. Follow the manufacturer's instructions.

## 2.11 CONDUIT SEALS (FOUNDATION WALLS)

- A. Modular elastomer type. EDM seal element. Nylon reinforcement. Pressure plate zinc plated bolts and nuts. Follow manufacturer's sizing chart and installation manual. Eaton Link Seal or equal.

# PART 3 EXECUTION

## 3.1 INSTALLATION

- A. Install nonmetallic conduit in accordance with manufacturer's instructions.
- B. Arrange supports to prevent misalignment during wiring installation.
- C. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- E. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.
- F. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- G. Do not attach conduit to ceiling support wires.
- H. Arrange conduit to maintain headroom and present neat appearance.
- I. Route conduit parallel and perpendicular to walls or building centerlines.
- J. Route conduit installed above accessible ceilings parallel and perpendicular to walls. Install metal conduit sleeves or fire rated assembly in all fire rated wall as identified on the electrical or architectural life safety plans.
- K. Route conduit in and under slab from point-to-point.



- L. Do not cross conduits in slab.
- M. Maintain adequate clearance between conduit and piping.
- N. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- O. Cut conduit square using saw or pipecutter; de-burr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.
- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.
- T. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints. Use a UL listed expansion joint. If expansion length exceeds the manufactured expansion fitting, the use of PVC coated metallic flexible conduit is an acceptable method.
- U. Provide suitable pull wire in each empty conduit except sleeves and nipples.
- V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Ground and bond conduit under provisions of Section 26 05 26.
- X. Identify conduit under provisions of Section 26 05 53.
- Y. Firestop the conduits passing thru fire rated walls. Electrical Contractor shall be responsible to review the Architectural Life Safety drawings for fire rated wall locations.
- Z. The control system contractor shall be responsible to adhere to the mechanical plans and/or temperature control system drawings to establish conduit routes.
- AA. Electrical Contractor shall be required to install new conduit (concealed) in all finished areas for the following, but not limited to: exit lights, clocks, light fixtures, receptacles, sensors, switching, fire alarm manual pull stations, horn/strobe unit and strobe units, etc. Saw cut, channel and patch the walls. Neatly saw cut all existing brick veneer, glazed block or tiled areas to complete the new work. Firestop all conduits passing through fire rated walls, floors or separation barriers. Take the necessary steps to prevent chipping during the saw cutting and or wall channeling operation in the brick veneer, glazed tile or

block areas. It shall be acceptable to install conduit from the opposite wall side to minimize brick veneer, glaze block or tile work. In non-finished spaces such as janitor closets, mechanical rooms, hub rooms, electrical rooms and storage rooms, conduit can be surface mounted. Provide flush mounted device boxes in all new wall construction as shown on the architectural drawings. Conduit drops or MC cable shall be concealed in the new walls and as noted and specified on the drawings.

- BB. All power, voice, clock, public address, data, fire alarm, occupancy sensor lighting wiring installed in finished exposed spaces shall be installed in conduit.
- CC. Electrical Contractor shall install the non-metallic divided surface raceway as noted or shown on the drawings. Refer to Electrical plans for a typical raceway detail.
- DD. Low-voltage voice and data device conduit drops in lay-in ceiling areas shall only be required to be extended into the accessible ceiling space or to a cable tray as noted or specified on the drawings.
- EE. Contractor shall provide separate raceway for the inverter emergency power distribution system.
- FF. Electrical Contractor shall identify inverter emergency power. Identify all of the junction box cover plates with panelboard source ID and circuit number(s). Provide engraved label. Handwritten on the junction box cover plate is not acceptable.
- GG. Provide conduit wall sleeves for low-voltage wiring installation as shown and noted on the drawings. Firestop the conduit openings. Use fire rated wireway as specified or noted on the drawings.
- HH. Provide empty conduit for power assisted doors as noted and shown on the drawings.
- II. Provide empty conduit for security system as noted and shown on the drawings.

### 3.2 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods consistent with facility standards or this project specification. Contractor is responsible to review the Architectural drawings to determine fire rated locations.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket or detail to match roof type specified.

END OF SECTION

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SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Floor boxes.
- C. Pull and junction boxes.
- D. Fire alarm device boxes.
- E. Public address speaker backbox assembly.
- F. Clock boxes.
- G. TV outlet.
- H. Voice/data boxes.
- I. Occupancy sensor boxes.
- J. Receptacle elevator service pit box.
- K. Power assisted door boxes.
- L. Security system boxes.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- B. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

- D. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

#### 1.4 SUBMITTALS FOR REVIEW

- A. Provide submittal as listed in Section 26 01 00.

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

### PART 2 PRODUCTS

#### 2.1 BRANCH DEVICE BOXES

- A. Sheet Metal Outlet Boxes: Use 4" square stamped steel box with single gang device ring as general project requirement.
- B. Nonmetallic Outlet Boxes: NEMA OS 2. (Not permitted unless as noted on the drawing).
- C. Cast Aluminum Boxes: for exterior location use a single gang shallow box with thread hub connection. Provide gasketed cover by box manufacturer.
- D. Use masonry box in masonry walls.
- E. Use 4" octagon box for ceiling smoke detectors.
- F. Use in line non-metallic type box in non-metal surface raceway assembly as scheduled and detailed on the drawings.
- G. Elevator service pit box for the receptacle shall be NEMA 4 to meet State Elevator Code.

#### 2.2 FLOOR BOXES

- A. As scheduled on the drawing.

#### 2.3 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes
  - 1. NEMA 1 enclosure for interior location.
  - 2. NEMA 3R or 4X for exterior location.
  - 3. Stainless steel for food service area.

4. Non-metallic pull and junction boxes are not permitted for this project unless noted otherwise.

#### 2.4 OCCUPANCY SENSORS

- A. Refer to the manufacturer for box requirements.

#### 2.5 PUBLIC ADDRESS AND TELEVISION DISTRIBUTION SYSTEM

- A. Refer to Sections 26 06 50 and 27 13 33.

#### 2.6 VOICE AND DATA BOXES

- A. Use 4 11/16" square stamped steel box with a single gang device.

#### 2.7 POWER ASSISTED DOOR BOXES

- A. Provide 4" square box for palm button backbox for use by the installing vendor.

#### 2.8 SECURITY BOXES

- A. Provide empty 4" square boxes as noted and shown on the drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in locations as shown on Drawings, and as required for wire pulling, equipment connections and compliance with regulatory requirements.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
- D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- E. Maintain headroom and present neat mechanical appearance.
- F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- G. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- H. Install boxes to preserve fire resistance rating of partitions and other elements.
- I. Coordinate mounting heights and locations of outlets for counters, backsplashes, benches in casework and workstations.

- J. Locate outlet boxes to allow luminaires positioned as shown.
- K. Align adjacent wall mounted outlet boxes for switches, etc.
- L. Use flush mounting outlet box in finished areas. Surface mounted boxes are acceptable for non-finished spaces.
- M. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- N. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
- O. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- P. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- Q. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- R. Use adjustable steel channel fasteners for hung ceiling outlet box.
- S. Do not fasten boxes to ceiling support wires.
- T. Support boxes independently of conduit.
- U. Use gang box where more than one device is mounted together. Do not use sectional box.
- V. Use gang box with plaster ring for single device outlets.
- W. Install floor boxes flush with the finished floor.
- X. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations. Set floor boxes level.
- Y. Install in line boxes in the surface mounted raceway system as shown on the drawing.
- Z. Large Pull Boxes: Provide screwed cover or hinged enclosure in interior dry locations as noted or specified on the drawing.
- AA. Junction box cover plates installed above the ceiling shall be facing down.

### 3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for equipment connected under other sections.
- B. Refer to Section 28 31 00 for fire alarm mounting height.

- C. Install public address speaker backbox at locations noted or shown on the drawings. Confirm final ceiling location to avoid the interferences with light fixtures, fire alarm and HVAC diffusers.

### 3.3 ADJUSTING

- A. Adjust floor box flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

END OF SECTION

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SECTION 26 05 36

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cable trays and accessories.
- B. Wire mesh tray.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- C. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
- D. NEMA VE 1 - Metallic Cable Tray Systems.

1.4 SUBMITTALS

- A. Provide submittals as listed in Section 26 01 00.
- B. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.
- C. Product Data: Provide data for fittings and accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual routing of cable tray and locations of supports.

1.6 REGULATORY REQUIREMENTS



- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Husky.
- B. B-Line - Flex tray.
- C. Wiremold Fieldmate
- D. Cablofil.

### 2.2 LADDER-TYPE CABLE TRAY

- A. Description: NEMA VE 1, Class 20C ladder type tray.
- B. Material: Steel.
- C. Finish: ASTM A 123, hot dipped galvanized after fabrication.
- D. Inside Width: As indicated on drawings.
- E. Inside Depth: As indicated on drawings.
- F. Straight Section Rung Spacing: 6 inches minimum on center or as indicated on drawings.
- G. Inside Radius of Fittings: 12 inches or as indicated on drawings.
- H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

### 2.3 WIRE MESH CABLE TRAY

- A. Electroplated zinc galvanized steel wire.
- B. Width and side rail height as scheduled on the drawings.
- C. Provide all components, fittings, etc. for a complete installation above those specified.

### 2.4 CENTER RAIL CABLE TRAY

- A. Width and side rail and rung spacing as scheduled on the drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install metallic cable tray in accordance with NEMA VE 1.
- C. Support trays in accordance with Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 ft maximum.
- D. Use expansion connectors where required.
- E. Ground and bond cable tray under provisions of Section 26 05 26.
  - 1. Provide continuity between tray components.
  - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
  - 3. Provide #6 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
  - 4. Connections to tray may be made using mechanical or exothermic connectors.
- F. Install the wire mesh tray above the finished accessible ceiling space and as shown on the drawings. Avoid piping, duct interferences. Set up trade coordination meeting prior to installation to avoid construction conflict.
- G. Cable tray shall only be used for low-voltage cable systems. Divisions 25, 26 and 27 shall use the tray to manage the various low-voltage system wiring called for in the specifications and drawings. The low voltage system vendor, who is in a direct contract with the Owner, shall also use the cable tray as field determined by the installing vendor. Contractors shall install the cables equally on both of the tray's center support for an even weight distribution.
- H. Provide a center support rod for the tray support or a wall bracket mounting, or trapeze hanger. Provide all hardware, mounting brackets. Welding is not permitted to any roof steel beams or joists.
- I. Where cable tray passes thru fire rated walls, the following firestop methods are acceptable.
  - 1. Fire blankets installed in the tray on each side of the wall opening.
  - 2. Stop the cable tray short of the wall opening and use a fire rated framed cable transit barrier or fire rated wireway to free air the cables from the tray to fire rated assembly. Acceptable cable transit barriers are Rox System or equal Nelson. Acceptable wireway - EZ Path or approved equal.

END OF SECTION

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SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit
- B. Handholes

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. ANSI/IEEE C2 - National Electrical Code.
- B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- D. NEMA TC 2 - Electrical Plastic Tubing (ETP) and Conduit (EPC-40 and EPC-80).
- E. NEMA TC 3 - PVC Fittings for Use with Rigid PVC conduit and Tubing.
- F. AASTO - Standard Specification for Highway Bridges.
- G. ANSI/ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- H. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot Rolled, Commercial Quality.
- I. ANSI/IEEE C2 - National Electrical Safety Code.
- J. ASTM A48 - Gray Iron Castings.
- K. ASTM A123 - Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of exact routing of ductbank.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.7 PROJECT CONDITIONS

- A. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- B. Duct bank routing is shown on drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.

PART 2 PRODUCTS

2.1 PLASTIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.2 HANDHOLES

- A. As scheduled on the drawings.

2.3 HDPE CONDUIT

- A. Smooth seamless type suitable for direct burial application.
- B. PVC cement is not acceptable for HDPE to PVC connection. Acceptable conduit adhesive shall be "Bonduit" offered by Polywater.
- C. Use HDPE conduit couplers for transition to interduct, PVC or threaded steel conduit. Provide "E-loc" or electrofusion coupler type manufactured by Lamson Pipe Company or approved equal.

D. Refer to NEC 2017 Section 353 for the HDPE conduit connection and installation methods.

E. HDPE conduit is not acceptable for exposed installations.

### PART 3 EXECUTION

#### 3.1 PREPARATION

A. Prepare excavation in accordance with plans.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Labeling methods and standards.
- E. Conductor color coding and identification.
- F. Panelboard directory.
- G. Underground warning tape.
- H. Arc flash warning labels.
- I. Voice/data faceplates and data rack patch panel ports.
- J. Electrical distribution equipment.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

## PART 2 PRODUCTS

### 2.1 NAMEPLATES AND LABELS

- A. Nameplates:
  - 1. Engraved three-layer laminated plastic, black letters on white background for normal power.
- B. Locations:
  - 1. Each electrical distribution panelboard, switchboard and power panel.
  - 2. Each starter.
  - 3. Each disconnect.
  - 4. Each inverter
  - 5. Each lighting control Panel
  - 6. Each Data Rack
  - 7. Emergency circuit junction box cover plates.
  - 8. MDF/IDF patch panel ports.
  - 9. Voice/data outlets.
  - 10. Each VFD.
  - 11. Boiler e-stop station.
- C. Nameplate size minimum 1"x3" or match existing.

### 2.2 WIRE MARKERS

- A. Manufacturers:
  - 1. Brady or equal.
- B. Description: Tape type wire markers.
- C. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- D. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
  - 2. Control Circuits: Control wire numbers.

### 2.3 CONDUIT MARKERS

- A. Emergency raceway or specialty systems.
- B. Location: Furnish stencil or painted stripe for each Inverter conduit longer than 10 feet. Stencil painted stripe shall not be less than 10" long (i.e. red )
- C. Spacing: 20 feet on center.
- D. Color:
  - 1. 120, 208 volt inverter Power Supply: Red.

## 2.4 LABELING METHODS AND STANDARDS

### A. Engraved Labels

1. All electrical panels, starters, disconnect switches, terminal cabinets, fire alarm panel, nurse call system cabinet, personnel patient TV system cabinet or similar central system cabinet shall be permanently identified using engraved labels. These labels shall be secured with double face tape or mechanically fastened in applications where the tape may have a tendency to fail.
2. Normal power fed systems shall have white labels with black lettering. Lettering sizes may vary due to space constraints or to distinguish between main versus branch systems. Sizes should be consistent throughout the project, use the following guidelines:

Switchboard or Panelboard Main Label: 1" high minimum

Switchboard or Panelboard Branches 1/2" high minimum

Starters, Disconnects, VFDs, Boiler e-stop station 1/2" high minimum

Manual Motor Starters 1/4" high minimum

3. All labels shall identify where panel or equipment is fed from. Ex (panel A fed from MDP)

### B. Adhesive Tape Labels

1. Receptacles shall have the circuit number identified on the device cover plate using clear adhesive tape labels with 1/4" high printed block characters in black.
2. Provide circuit identification on junction or pull box covers for all circuits within.
3. Conductors in branch circuit panelboards shall have phase conductors, neutrals and grounds identified with adhesive labels within the panel at junction or pull boxes and at the device outlet box. Refer also to conductor color coding with respect to operating voltage.

## 2.5 CONDUCTOR COLOR CODING AND IDENTIFICATION

- A. Feeder phase conductors shall be identified as to phase and operating voltage using colored tape as follows:

|         | <u>480 Volt</u> | <u>120/208 Volt</u> |
|---------|-----------------|---------------------|
| Phase A | yellow          | black               |
| Phase B | brown           | red                 |



|         |        |       |
|---------|--------|-------|
| Phase C | orange | blue  |
| Neutral | gray   | white |
| Ground  | green  | green |

- B. Conductors from #18 up through #10 shall have colored insulating jackets to match the color code and phasing scheme as described above for feeders. Receptacle and lighting circuit conductors shall be #12 minimum for 15 or 20 amp circuits. Conductors #18 through #14 shall only be used for control circuits with colored jackets and wire numbers correlated to each system accordingly.
- C. Spare conductors shall be clearly identified as such through color, labels, tags, etc.

## 2.6 PANELBOARD DIRECTORY

- A. Provide typed directory. Handwritten is not acceptable.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

### 3.2 APPLICATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to inside surface of door on panelboard.
- C. Contractor shall review the drawings to confirm all label schemes or ID requirements listed or noted on the drawings. Review mechanical drawings for equipment ID designation to provide a ID tag that corresponds to the mechanical equipment.
- D. Provide arc flash generic warning label on all electrical distribution equipment in accordance with NEC 2017 requirements.
- E. Panelboard, switchboards, transformers, etc. shall include their source of power included in nameplate label. (i.e. LPA feed from PP2)

END OF SECTION

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SECTION 26 05 83  
WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mechanical equipment.
- B. Food service.
- C. Powerized modular furniture.
- D. Occupancy sensor equipment.
- E. Owner furnish equipment.
- F. Electrical water cooler
- G. Blank feed thru GFI

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 COORDINATION

- A. Coordinate work under provisions of Division 1.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.

- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.
- F. Provide a 120 volt power supply in a junction box for use by the sprinkler contractor to connect to main sprinkler riser flow switch.
- G. Mechanical Trades shall be responsible to furnish and install all temperature control components, associated conduit, wiring and 120 volt power supplies. Electrical Trades shall reserve 120 volt circuit breaker as scheduled in the panels for this purpose.
- H. All VFD programming shall be completed as part of the Mechanical Trades work.
- I. Provide a readily accessible GFI outlet for electrical water cooler.
- J. Where equipment will cover a GFI outlet within 6 feet of sink, provide a blank feed thru GFI test station.

## 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 CORDS AND CAPS

- A. Manufacturers:
  - 1. Hubbell, Pass & Seymour, Leviton or equal.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: ANSI/NFPA 70, Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over current protection.

### 2.2 BOILER DISCONNECT SWITCH

- A. Lockable type to meet ASME-1 2009 Standard.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify conditions under provisions of Division 1.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

#### 3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using metallic flexible conduit for all dry interior locations. Use liquid tight non-metallic flexible conduit with watertight connectors in damp or wet locations and kitchen areas.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide the NEMA configuration that matches receptacle.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, power relays, motor starters and as noted on the drawings.
- G. Provide and install fuses in mechanical trades furnished fused disconnects and combination starters per manufacturer's requirements.
- H. Final power connection to powerized furniture shall be completed by the Electrical Trades. Where the furniture system utilizes shared neutrals, the Electrical Trades shall furnish and install a circuit breaker tie.
- I. Complete all lighting controls as scheduled, noted and shown on the drawings.
- J. Electrical Contractor shall complete all main power wiring to the mechanical equipment shown and noted.
- K. VFD control wiring and programming shall be completed as part of the Mechanical Trades bid. VFD shall be factory installed with the equipment unless noted or specified otherwise.

#### 3.3 BLANK FEED THRU GFI

- A. Install a remote blank feed thru GFI where a refrigerator, freezer or other equipment that blocks access to the receptacle located within 6 feet of a sink.

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

END OF SECTION

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SECTION 26 09 23  
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power packs.
- B. Occupancy sensor.
- C. Relay panels.
- D. Low voltage push button stations.
- E. CAT 5E wiring.
- F. Low-voltage momentary switching.
- G. Fire alarm interface.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. ASHRAE 90.1 2013 Energy Code.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- C. 2015 Michigan Energy Code.

1.4 SUBMITTALS

- A. Provide submittal as listed in Section 26 01 00.
- B. Shop Drawings: Occupancy sensor cut sheets, control panel layouts, wiring connections, diagrams, and dimensions. Cut sheets shall either be marked or arrowed components with catalog numbers. Failure to comply will be cause to return the submittals for corrections at no delays or extra costs to the Owner.

1.5

## REGULATORY REQUIREMENTS

- A. ASHRAE 90.1 2013.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- C. Products: Furnish products listed or labeled to conform to requirements of 2017 National Electric Code, 2017 State of Michigan Electric Code Rules Part 8, and local authority having jurisdiction.
- D. 2015 Michigan Energy Code.
- E. 2015 Life Safety Code. NFPA 101. Chapter 7 – 7.8.1.2.2 Means of Egress Lighting.

## PART 2 PRODUCTS – Acceptable manufacturer's – as scheduled on the drawings.

### 2.1 OCCUPANCY SENSORS

- A. As scheduled on the drawings.

### 2.2 POWER PACKS

- A. As scheduled on the drawings.

### 2.3 CEILING MOUNTED OCCUPANCY SENSORS

- A. As scheduled on the drawings.

### 2.4 WALL SWITCH TYPE OCCUPANCY SENSORS

- A. As scheduled on the drawings.

### 2.5 RELAY PANEL

- A. As scheduled on the drawings.

### 2.6 CAT 5E WIRING

- A. Green jacketed cable color.

### 2.7 LOW VOLTAGE DIGITAL CONTROL STATION

- A. As scheduled on the drawings.

### 2.8 LOW-VOLTAGE MOMENTARY SWITCHING

- A. As specified or scheduled.

### 2.9 ADDRESSABLE RELAY FOR FIRE ALARM INTERFACE

- A. As scheduled on the drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and wiring diagrams.
- B. Contractor shall provide all components, etc. above those specified or shown for a complete installation.

#### 3.2 SYSTEM TRAINING

- A. Include (2) 4 hours of training with the bid, four-hour training sessions. These training sessions shall be on different days, which will require two separate trips by the instructor. The training shall take place at the Owner's facility.

#### 3.3 FUNCTIONAL TESTING

- A. Provide functional testing with 2013 ASHRAE.
- B. Provide certified documents that lighting controls were tested for programming and working conditions.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards.
- B. Branch circuit panelboards.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA KS 1 - Enclosed Switches.
- D. NEMA PB 1 - Panelboards.
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- F. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 SUBMITTALS

- A. Provide submittal as listed in Section 26 01 00.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

- D. Panelboard submittal shall match drawing schedule arrangement. Submittal shall custom edit schedules to match design drawings.
- E. Manufacturer and Contractor shall verify the overcurrent protective device to match wire size as shown and noted in the bid documents.

#### 1.5 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. As scheduled on the drawings.

#### 2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, circuit breaker type or fusible switch type per plan.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
- D. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- E. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1. Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
- F. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.

- G. Provide circuit breaker accessory trip units and auxiliary switches as indicated.
- H. Cabinet Front: Surface type, fastened with concealed trim clamps, hinge and latch. Provide hinged door with flush lock. Finish in manufacturer's standard gray enamel.

## 2.3 BRANCH CIRCUIT PANELBOARDS

- A. As scheduled on the drawings.

## 2.4 FUSES

- A. Manufacturers:
  - 1. Bussman, or equal.
- B. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 600 volt.
- C. Fuses 601 Amperes and Larger: Current limiting, time delay one time fuse, 600 volt, UL Class L.
- D. Interrupting Rating: 200,000 rms amperes.

## 2.5 ARC ENERGY REDUCTION

- A. Furnish an energy reducing maintenance switch for a circuit breaker rated 1200 amps or higher.

# PART 3 EXECUTION

## 3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- F. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
- G. Arc-fault protection is required on all 120 volt branch circuits supplying 15 amp and 20 amp receptacles installed in dwelling units.

## 3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed to assure proper operation.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates.
- D. Floor box service fittings.
- E. Poke-through service fittings.
- F. Tamper resistant receptacles.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. NEMA WD 1 - General Requirements for Wiring Devices.
- B. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- C. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- D. ADA - Americans with Disabilities Act - As amended.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

## 2.1 WALL SWITCHES

- A. Manufacturers:
  - 1. Pass & Seymour, Hubbell, Leviton or equal.
- B. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- C. Body and Handle: Color to be determined from standard colors by the Architect.
- D. Ratings:
  - 1. Voltage: 120/277 volts, AC.
  - 2. Current: 20 amperes.

## 2.1 WALL DIMMERS

- A. Manufacturers:
  - 1. As scheduled on the drawings.

## 2.2 RECEPTACLES

- A. Manufacturers:
  - 1. Hubbell, Pass & Seymour, Leviton, or equal
- B. Description: NEMA WD 1, Heavy-duty specification grade tamper resistant duplex receptacle.
- C. Device Body: Color to be determined from standard colors by the Architect.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- G. Damp and wet location receptacles shall be rated "WR".
- H. Tamper Resistant Receptacles
  - 1. All 15 amp and 20 amp receptacles shall be listed tamper resistant.

## 2.3 WALL PLATES

- A. Cover Plate: Stainless Steel.
- B. Use "in use" weather proof metallic covers at exterior locations as indicated on the drawings to meet 2017 NEC Section 406.
- C. Provide blank metal cover plates on abandoned boxes.
- D. Provide stamped metal cover plate for unfinished spaces.

## 2.4 FLOOR MOUNTED SERVICE FITTINGS

- A. As scheduled on the drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that floor boxes are adjusted properly.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

### 3.3 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole on bottom.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper or branch circuit equipment grounding conductor where specified.
- E. Install plates on switch, receptacle, and blank outlets in finished areas.
- F. Connect wiring devices by wrapping conductor around screw terminal.
- G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- H. Install protective rings on active flush cover service fittings.
- I. Install the boiler emergency shutdown switch at each main boiler room area entrance.
- J. Shared neutral are not permitted for lighting and power circuits.

### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Confirm with architectural drawings for counter casework, etc. details for wiring devices mounting heights.
- B. Install wall switch 48 inches to top of box above finished floor.
- C. Install convenience receptacle 16 inches to bottom of box above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.
- E. Install dimmer 48 inches to top of box above finished floor.
- F. 18" mounting height is lieu of the 16" minimum specified is acceptable pending masonry course lines.
- G. Electrical Trades shall review 2009 ANSI 117.1 for ADA requirements. Obtain a copy as required.
- H. Refer to all other sections of the specification, drawings, and Architectural drawing for specific mounting requirements for clocks, receptacles shown in counters, work stations. Do not rely solely on the electrical drawings for this information. Division 26, 27 & 28 Contractor shall be responsible to review all project documentation and obtain all required information from the district.
- I. Refer to section 28 31 00 and drawing notes for fire alarm device mounting heights.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

### 3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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SECTION 26 28 13

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual fuse sizes.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussman or equal.

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. Main Service Switches Larger than 600 amperes: Class L (time delay).

### 2.3 CLASS RK1 (TIME DELAY) CURRENT LIMITING FUSES

A. Manufacturers:

1. Bussman or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Install fuses in accordance with manufacturer's instructions.

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches.
- B. Nonfusible switches.
- C. Fuses.

1.2 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- D. UL 198E - Class R Fuses.

1.3 SUBMITTALS

- A. Provide submittal as listed in Section 26 01 00.
- B. Product Data: Provide switch ratings and enclosure dimensions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. As scheduled on the drawings.

## 2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type Heavy Duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type Heavy Duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 3R.
- D. Disconnect switches serving the elevator main power must be a heavy duty type to meet the State of Michigan Elevator Code. Disconnect switch shall include auxiliary contacts for use by the elevator contractor to send a signal the main power disconnect is open.

## 2.3 FUSES

- A. Manufacturers:
  - 1. Bussman or equal.
- B. Description: Dual element, current limiting, time delay, one-time fuse, 600 volt.
- C. Interrupting Rating: 200,000 rms amperes.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install disconnect switches where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
- D. Contractor shall confirm final elevator main power requirements to properly size the disconnect switch and fusing.
- E. Electrical Contractor shall be responsible to review the mechanical equipment schedules to determine if any factory installed switches are scheduled and noted as part of the equipment to minimize duplication by electrical trades.
- F. Furnish and install a separate lockable fusible disconnect switch for the elevator car fan and light.

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- G. Furnish and install a lockable fusible disconnect switch for each boiler main incoming power disconnecting means to meet the State's Boiler Code Division requirements.

END OF SECTION

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SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manual motor starters.
- B. Combination magnetic motor starters.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- C. UL 198E - Class R Fuses.
- D. NEMA AB 1 - Molded Case Circuit Breakers.
- E. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- F. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- G. NEMA KS 1 - Enclosed Switches.

1.4 SUBMITTALS

- A. Provide submittal as listed in Section 26 01 00.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under

Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

## 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. As scheduled on the drawings.

### 2.2 MANUAL CONTROLLERS

- A. As scheduled on the drawings.

### 2.3 POWER RELAYS.

- A. As scheduled on the drawings.
- B. Furnish and install the power relay for the new mechanical equipment as shown on the drawings to allow for interface by the BAS contractor.

### 2.4 COMBINATION MOTOR STARTERS

- A. As scheduled on the drawings.

### 2.5 UNIT HEATERS

- A. Provide manual motor starter as noted and shown on the drawing.
- B. Electrical Trades shall install and wire all loose pump starter panels furnished as part of Mechanical Trades. Electrical Trades shall be responsible to determine what mechanical equipment will have loose equipment and include costs as part of the bid submitted. Contact the mechanical bidders to obtain all information. All control wiring shall be completed as part of the temperature control contractor bid.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

- B. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 ft to operating handle.
- D. Install fuses in fusible switches.
- E. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- G. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

### 3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed for proper operation.
- B. Inspect and test each enclosed controller to NEMA ICS 2.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires per schedule.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- C. NFPA 101 - Life Safety Code, current adopted edition.
- D. 2015 Michigan Energy Code.
- E. ASHRAE 90.1 2013 Edition.
- F. LED Standards LM 79 and LM 80.

1.4 SUBMITTALS FOR REVIEW

- A. Provide submittal as listed in Section 26 01 00.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Conform to requirements of NFPA 101.

- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- D. 2015 Michigan Energy Code.

## PART 2 PRODUCTS

### 2.1 LUMINAIRES

- A. Furnish Products as scheduled on the drawings.

### 2.2 LED DRIVERS

- A. LED drivers shall include a factory disconnecting means in accordance with 2017 NEC 410-130G.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- B. Support luminaires independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips at a minimum of (4) points of attachment to prevent movement.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place at a minimum of (4) points of attachment to prevent movement.
- I. Install wall mounted luminaires at height as indicated on Drawings and/or architectural drawings.
- J. Install accessories furnished with each luminaire.
- K. Connect emergency luminaires and exit signs to the emergency distribution or inverter as noted and shown on the drawings.

- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Luminaires specified with factory installed battery drivers shall be wired as noted and shown on the drawings.

### 3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### 3.3 ADJUSTING

- A. Contract Closeout: Division 1: Adjusting installed work.
- B. Aim and adjust luminaires as indicated or as directed.
- C. Position exit sign directional arrows as indicated.

### 3.4 CLEANING

- A. Contract Closeout: Cleaning installed work.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

### 3.5 DEMONSTRATION AND INSTRUCTIONS

- A. Replace light fixtures with non-working LED's, broken or discolored lens.

### 3.6 PROTECTION OF FINISHED WORK

- A. Contract Closeout: Protecting installed work.

### 3.7 SCHEDULES

- A. Refer to Drawings.

END OF SECTION

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SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires and accessories.
- B. Watertight wiring connectors.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. LED Standards LM 79 and LM 80.
- B. ANSI O5.1 - Specifications and Dimensions for Wood Poles.
- C. IES 10<sup>th</sup> Edition.
- D. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- E. 2015 Michigan Energy Code.

1.4 SUBMITTALS FOR REVIEW

- A. Provide submittal as listed in Section 26 01 00.
- B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- C. Michigan Uniform Energy Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Material and Equipment: Transport, handle, store, and protect products.
- B. Store and handle solid wood poles in accordance with ANSI O5.1.

1.7 COORDINATION

- A. Coordination, refer to Division 1.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

PART 2 PRODUCTS

2.1 LUMINAIRES AND ACCESSORIES

- A. Furnish Products as scheduled on the drawings.

2.2 POLES

- A. As scheduled on drawings.

2.3 WATERTIGHT WIRING CONNECTORS.

- A. Furnish removal connector assembly either fused or non-fused.
- B. Provide in-line connector type for single circuit application.
- C. Provide Y type connector to permit splitting of the circuit.
- D. Acceptable manufacturers for in line or y connectors: Buchanan 84, 65 Series or equal by Homic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Bond luminaires to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.
- B. Cutting of the anchor bolts to make light pole corrections in the field is not permitted. Contact the Structural Engineer for review and assistance.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- B. Measure illumination levels to verify conformance with performance requirements.
- C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

### 3.3 ADJUSTING

- A. Contract Closeout: Adjusting installed work, refer to Division 1.
- B. Aim and adjust luminaires to provide illumination levels and distribution as specified.

### 3.4 CLEANING

- A. Contract Closeout: Cleaning installed work, refer to Division 1.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

### 3.5 PROTECTION OF FINISHED WORK

- A. Contract Closeout: Protecting installed work, refer to Division 1.

### 3.6 SCHEDULE

- A. Refer to drawings.

END OF SECTION

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SECTION 27 05 28

PATHWAYS FOR COMMUNICATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Voice/Data raceway.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. EIA/TIA-568 - Commercial Building Wiring Standard.
- B. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces.
- C. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 SYSTEM DESCRIPTION

- A. Telephone Service Entrance Pathway: Nonmetallic from point of telephone utility connection at property line to building service terminal backboard.
- B. Backbone Pathway: Conform to EIA/TIA 569 using combination of conduit and sleeves as indicated.
- C. Horizontal Pathway: Conform to EIA/TIA 569, using raceway, backboards as indicated.
- D. Voice/Data wiring: By Division 27 contractor.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations and sizes of pathways and outlets.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## PART 2 PRODUCTS

Section Not Used

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install raceways in accordance with EIA/TIA 568.
- B. Support raceways and cabinets under the provisions of Section 26 05 29.
- C. Install recessed cabinets flush with wall finishes, and stub 5 empty 1 inch conduits to accessible location above ceiling at each location.
- D. Install polyethylene pulling string in each empty voice conduit over ten feet in length or containing a bend.
- E. Install a #6 AWG green ground wire to backboard from service entrance ground bar in main panel.
- F. Voice/data outlet minimum mounting heights shall match duplex receptacles. Refer to Section 26 06 24.

END OF SECTION

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SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Data patch panel.
- B. Cable management.
- C. Voice/data/terminations.
- D. Wall station faceplate.
- E. Category 6 cable.
- F. Voice cable.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. ANSI EIA/TIA-568-B.2, 568-B.2, 568-B.3 - Commercial Building Wiring Standard.
- B. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. A record shall be compiled and provided to the owner in compliance with the ANSI EIA/TIA 606-A standard.
- B. Each horizontal cable shall be tested in accordance with ANSI EIA/TIA 568-B.2 to verify compliance. Passable test per cable segment shall be submitted to the Owner.

1.6 SUBMITTALS

- A. Provide submittals as listed in Section 26 01 00. The submittal shall be prepared by manufacturer's representative. Supply house or contractor's prepared submittals will be returned
  - B. Submittals shall include the total MDF/IDF rack layout include patch panels, cable management, relay rack and all component cut sheets. Mark or arrow cut sheets with catalog numbers. Failure to comply will be cause to return the submittals for corrections at no delays or extra costs to the District.
- 1.7 SCOPE OF WORK, BUT NOT LIMITED TO THE FOLLOWING
- A. Furnish and install Contractor furnished system components for a complete operating and tested system.
    - 1. General Requirements:
      - a. Contractor shall furnish and install new fiber optic, fiber terminations, racks, grounding, cable management, CAT 6 cabling, jacks and faceplate. Include all terminations to serve the new voice, data, wireless access points.
    - 2. Specific Project Requirements:
      - a. Remove all existing voice and data cabling from the station side outlets, to the existing distribution frames. Removal shall include all wiring installed from the ceiling space.
      - b. Furnish and install the fire rated wireway specified for cables passing thru fire rated walls as as noted and shown on the drawings.
      - c. Furnish and install multi-port faceplate with modular jacks suitable for in-line device mounting with the raceway or flush mounted backbox.
      - d. Provide J hooks, in addition to the wire mesh cable tray. Nylon ties for supports or bundling of new cables are not permitted.
      - e. Complete all new voice, data that exits from the MDF or IDF frames to serve the station side outlets.
- 1.8 SCOPE OF WORK
- A. The Contractor shall be responsible to rework, remove or upgrade the cable CAT6 cable infrastructure. All other work from these service entrance points shall be furnished and installed by the Contractor.
- 1.9 PERMITS
- A. Contractor shall obtain and pay all permit costs and inspection fees for voice and data device drops.
- 1.10 PRE-START CONFERENCE
- A. The Contractor shall be responsible to set up a pre-start meeting with the construction manager or the Owner's technology vendor to determine installation phasing and actual work installation methods prior to starting this phase of the work.

## PART 2 PRODUCTS

### 2.1 PATCH PANEL.

- A. Belden CAT6+ REVConnect.

### 2.2 PATCH CORDS (Field confirm length). Belden 3'-10" minimum, 10'-0" standard. However, a longer length shall be furnished for a complete operating system.

- A. Blue-Data
- D. No red, to avoid conflict with fire alarm cables.

### 2.3 WALL STATION FACEPLATE

- A. Flush mounted single gang, minimum 4 port. Include white, C6, RJ45, Beldebn modular jack insert for data. Contractor to review the drawing for each station to determine quantity and type. Faceplate covers shall be stainless steel.

### 2.5 IDF/MDF RACK EQUIPMENT

- A. Contractor shall furnish, install and terminate patch panels, cable management components, labeling, wall station faceplate terminations and certifications. Contractor shall review the owner's existing rack installation to gain knowledge and technical information methods for design, layout and installation for this project's requirements. Network/communication shop drawing submittals shall include cut sheets of the rack, patch panel, rack layout, face plates, , modular jacks, CAT 6 wiring and patch cords.
- B. Contractor shall be responsible to design, layout, and arrange the rack equipment and associated components for a complete system installation. Contractor shall also be responsible to make all field adjustments as directed by the district as well.
- C. Provide components to meet school standards. Hub switches shall be furnished and installed by the owner.

### 2.6 CATEGORY 6 CABLE

- A. Belden REV Connect 3600. 23 awg solid copper, FEP insulation, type MPP/CMP. 4 pair, plenum cable and rated for cable tray installation. Minimum performance 350 MHz.  
Blue jacket - data

### 2.7 FIBER OPTIC CABLE

- A. Corning Freedom One 12 strand single mode indoor/outdoor plenum rated armoreda.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Furnish and install all voice/data components in accordance with plans and specifications.
- B. Contractor shall complete all terminations, testing and certifications in accordance with ANSI EIA/TIA 568-B.2 standard. Testing includes all components: cable, patch cords, equipment cords and connecting hardware for copper cable. Fiber optic cable shall be tested to verify length, continuity, and measure loss and/or attenuation.
- C. Label data rack equipment, closet side, station side cables, faceplates.
- D. Firestop all wall sleeve openings conduits and cables installed through the sleeve.
- E. All terminations and test each cable in accordance with the ANSI EIA/TIA 568-B.2 standard. Passable test results per cable shall be provided to the Owner. Written final documentation shall be furnished at closeout of project and serve as part of the as-built records.
- F. Network/Communication cables shall not exceed bend radius or pulling tension. Obtain manufacturer's data prior to starting this phase of the work.
- G. Review the school's facility wide standards voice/data rack installation to gain a knowledgeable insight and technical installation methods for this project.
- H. Contractor shall install data C6 UTP cables from each work station to patch panel in accordance with plans and specification. Each cable shall be a "home run" back to telecommunications room and/or IDF. Splices are not acceptable.
- I. Provide modular jack RJ45 type or as specified.
- J. Furnish and install cable management devices above accessible ceilings including J hooks, cable trays and conduit raceways. Provide EMT conduit for physical protection of all low voltage system cables in finished exposed areas. Use the cable tray where ever available as noted or shown on the drawings.
- K. Provide firestop caulk for all conduit sleeves and fire rated wireway as shown on the drawings.
- L. Arrange with the Owner during the bid phase to visit an existing facility to review rack configuration, equipment layouts, labeling, patch cords, faceplate modular jack color and labeling scheme.
- M. Provide cable maintenance loops at the racks for all voice and data cables.
- N. Install voice C6 UTP cables from each work in accordance with plans and specifications. Each cable shall be a "home run" back to the telecommunications room and/or IDF. Splices are not acceptable.
- O. Minimally compliant cable and connectivity is not acceptable.
- P. Project will require a certified installer and as such, will provide the Owner with a manufacturer's warranty.

NEW ADDITION AND RENOVATION FOR:  
MIDLAND COUNTY ESA  
MIDLAND, MICHIGAN

PROJECT NO. 2022006.1

END OF SECTION

MAI: 2022-1535

SECTION 28 46 13

FIRE ALARM SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. New Voice Evacuation point addressable main fire alarm panel, devices, and new NAC panels.
- B. Fire alarm system shall not be limited to: Manual pull stations, magnetic door holders, duct smoke detectors, ceiling smoke detectors, audio/visual devices and visual devices. Include all associated code mandated components, wiring for a complete operating system.
- C. Fire alarm ADA signaling devices.
- D. Fire alarm wiring.
- E. Unit Prices: Provide a unit price for complete device installation as listed: Manual pull stations, audio/visual devices, smoke detectors, duct smoke detectors, conduit, backboxes and wiring. Refer to the Bid Proposal Form for associated requirements.
- F. Combination smoke/fire dampers shall be furnished and installed as part of Mechanical Trades bid. It shall be the responsibility of the Electrical Trades to review the mechanical drawings for damper locations. Do not rely solely on the electrical drawings.
- G. Fire protection system. Electrical Trades shall complete all flow and switch wiring to the fire alarm system. The flow and tamper switches shall be furnished and installed as part of the fire protection contractor's bid. Electrical Trades shall furnish and install a flush mounted backbox, an exterior horn/strobe and wiring to the fire alarm system. Electrical Trades shall be responsible to contact the fire protection contractor to confirm flow and tamper switch quantities and locations, and include all costs.
- H. The fire alarm vendor shall be responsible to review the Architectural door schedules and hardware specification section to include all magnetic door holder devices above those specifically shown on the electrical drawings and include all fire alarm panel points.
- I. Complete fire alarm wiring to the fire pump controller, flow and tamper switches. Fire pump controller minimum monitoring points shall include phase loss, phase reversal, power loss and frequency sensitivity.
- J. The Fire Alarm vendor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect

and Engineer related to Contractor use of the CAD files shall be signed by the Fire Alarm vendor.

## 1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

## 1.3 REFERENCES

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.
- B. NFPA 72 - Current adopted code.
- C. NFPA 101 - Life Safety Code, current adopted code.
- D. State of Michigan - Bureau of Fire Services for Fire Alarm Plan Review and Inspections.
- E. State of Michigan, 2016 School Rules.
- F. NFPA 90A Current Adopted Code
- G. NFPA 92A Current Adopted Code
- H. NFPA 92B Current Adopted Code
- I. UL References:
  - UL 864
  - UL268
  - UL268A
  - UL 217
  - UL 521
  - UL 228
  - UL 464
  - UL 38
  - UL 1481
  - UL 1711

## 1.4 SUBMITTALS

- A. Provide submittal as listed in Section 26 01 00. Submittal cut sheets shall be arrowed or marked with catalog numbers. Failure to comply will be cause for returning submittal for corrections at no delays or extra cost to the Owner.

- B. Shop Drawings: Provide control panel layout and system wiring diagram showing each device and wiring connection required.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations for complete fire alarm system.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit as specified.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

#### 1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of 2015 Michigan Building Code, 2017 National Electrical Code, 2017 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements .
- B. NFPA 72 - Current adopted edition.
- C. NFPA 101 - Life Safety Code, current adopted edition.
- D. State of Michigan, Bureau of Fire Services for Plan Review and Inspections.
- E. State of Michigan, 2016 School Rules.
- F. NFPA 90A Current Adopted Edition.
- G. NFPA 92A Current Adopted Edition.
- H. NFPA 92B Current Adopted Edition.
- I. UL References:
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  - UL268
  - UL268A
  - UL 217
  - UL 521
  - UL 228
  - UL 464
  - UL 38
  - UL 1481
  - UL 1711

#### 1.8 SCOPE OF WORK



- A. This bid package shall include fire alarm panel, all devices and associated NAC panel, wiring and system certification ready for interconnection to one main fire alarm control panel, and a remote annunciator panel as specified.
- B. Provide fire alarm device unit prices in accordance with Instruction to the Bidders, and as listed on the Bid Proposal Form.
- C. Provide fire alarm wiring and a 120 volt circuit to any combination smoke/fire dampers as shown on the Mechanical drawings. Electrical Trades shall be responsible to review the Mechanical drawings in addition to the Electrical plans. Mechanical plans shall govern damper location. Interwire to the associated duct smoke detector in accordance with the manufacturer's wiring instructions. Duct smoke detector shall be provided and wired by Electrical Trades, unless specifically listed on the damper schedules.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Simplex, Siemens, or Edwards EST,
- B. U.L. requirements. All devices must be U.L. 864 9<sup>th</sup> Edition compatible with the control panel.

### 2.2 OPERATION

- A. The operation of any manual pull station, flow switch, smoke detector, duct smoke detector, shall cause the sounding of all alarm horns on a temporal pattern basis, sequential flashing of system strobes, activate common alarm relay contacts on the control panel and indicate on the control panel's LCD display the zone and type of device sounding the alarm.
- B. In addition, the operation of any duct smoke detector shall shut down its associated fan or damper motor. Complete interwiring between detector and mechanical equipment control panel.
- C. Refer to the current adopted NFPA 72 Fire Alarm Code for the allowable detector distance and location from the pair of doors.
- D. The operation of the panel mounted alarm silencing switch will turn off all horns but the strobes will continue to flash until the device actuating the alarm is reset to its normal position and the panel mounted system reset button is operated, at which time the system will return to its normal stand by (supervisory) mode.
- E. Any system trouble condition such as an open circuit or ground condition will activate a common trouble LED and indicate on the control panel LCD display the exact zone, circuit or internal panel condition causing the trouble condition. Correction of the trouble source will return the panel to its normal standby mode.

- F. Initiating device circuits shall be two-wire style B, and horn or strobe circuits shall be two-wire style Y utilizing end of line resistors for circuit supervision. All wiring to initiating and signaling devices shall be looped and continuous to the end of line resistor on its respective circuit. T-tapping is not permissible.

## 2.3 FIRE ALARM CONTROL PANEL

- A. New point addressable panel sized properly for the facility, with a minimum of 30% spare capacity.

## 2.4 DEVICES (all point addressable type that is compatible to the main panel)

- A. Manual Pull Stations: Provide single action stations. Key reset. Provide wire guards as shown on the drawings. Refer to the plans for specific keyed notes that address the pull station installation.
- B. Smoke Detectors: Provide photoelectric type with two wire base for mounting to a 4" octagon box. Furnish smoke detectors for control of the magnetic door holder as shown and noted on the plans. Refer to the current adopted NFPA 72 Fire Alarm Code for the allowable detector for locations.
- C. Duct Smoke Detectors: Provide duct detector housing with photoelectric type smoke detector, and sampling tubes. Each duct smoke detector shall have its remote alarm LED.
- D. Audio/Visual Units: Provide horn and strobe units with 24VDC horn and ADA approved strobe for mounting to a 4" square box. Refer to the drawings for candela rating.
- E. Visual Units: Provide complete with ADA-approved strobe for mounting to a single gang box. Refer to the drawings for candela rating.
- F. Magnetic door holder. Flush wall unit. Minimum 25 pound holding force, 120 volt operation. Furnish addressable relay for each pair of doors, also include the door plate with holder assembly. Refer to door hardware schedule for additional project requirements, and for holder type. The schedule shall govern and the holders shall be provided, installed and wired to the fire alarm panel.
- G. Audio/visual and visual units shown for ceiling installation shall include vertical lettering. Horizontal lettering is not acceptable.

## 2.5 FIRE ALARM WIRING

- A. Use (1) pair #18/2 twisted shielded for initiating devices unless directed otherwise by the manufacturer.
- B. Use (1) pair #14 for power duct smoke detectors as directed by the manufacturer.
- C. Use (1) pair #14 for horn/strobe circuits as directed by the manufacturer.

- D. Use (2) pair #18 for control to remote alarm and test station with duct smoke detector.
- E. All fire alarm wiring shall be in compliance with NEC Article 760.
- F. Magnetic door holder wiring. Furnish addressable relay for each pair of doors. Interwire the door holder to the main fire alarm panel. Complete the associated ceiling smoke detectors wiring to the holders and to the main fire alarm system.
- G. Fire alarm supplier to provide circuiting to comply with voltage drop and load calculations per Code requirements.
- H. All wire sizes indicated are minimum.

## 2.6 NAC PANEL

- A. The fire alarm vendor shall be responsible to complete all engineering and voltage drop calculations to determine the NAC panel location and quantities. Division 28 Contractor shall be responsible to contact the competitive vendors listed for the location and quantities for wiring to and 120 volt power. Include the costs as part of the bid. Wiring to a local general purpose receptacle is an acceptable method. Provide a smoke detector for each NAC panel and wiring to the main fire alarm panel.

## 2.7 POWER SUPPLIES

- A. Fire alarm vendor shall furnish and install power supplies as required for a complete operating system. Electrical Trades shall field select the location as advised by the fire alarm vendor.

## 2.8 REMOTE ANNUNCIATOR

- A. Semi-flush mounting.
- B. Push to test buttons.
- C. Silenced troubled.
- D. Key locked door.
- E. Reset button.

## 2.9 AUDIO ANNUNCIATION

- A. All call
- B. Page to EVAC
- C. Page to alert.
- D. Page by phone.

2.10 REMOTE MICROPHONE

- A. Push to talk
- B. 24VDC

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fire alarm wiring in conduit for device shown storage room, mechanical rooms and similar space. Use 5'-0" minimum conduit drop in for physical protection.
- B. All junction boxes for fire alarm raceway system shall be painted red labeled "FIRE ALARM". Junction boxes installed in theatrical space where the project requires a black room finish scheme, label the junction box "fire alarm".
- C. Provide and install the fire alarm system in strict accordance with the plans and specifications, codes and manufacturer's instructions.
- D. Fully test the fire alarm system in accordance with NFPA 72, Chapter 7.
- E. Division 26 Contractor and the fire alarm vendor shall be responsible for furnishing devices above those shown on the drawings as required to meet the inspector's system walk-thru.
- F. Duct smoke detector low voltage wiring to the main fire alarm panel shall be installed in separate raceway to meet code requirements. The detector's 120v motor shut down wiring must maintain physical separation.
- G. Fire alarm vendor shall be responsible to certify the sound coverage for the entire facility.
- H. Audio/visual and visual units shall be installed in accordance with Michigan Building Code under the fire protection system section or NFPA 72 Fire Alarm Code wall mounted appliance shall be mounted such that the entire lens is not less than 80 inches, and not greater than 96 inches above the finished floor. Ceiling mounted device is an acceptable method. Ceiling mounting devices are designated with a C subscript letter.
- I. Manual pull stations shall be mounted a maximum of 48" from the floor level to the activating handle or to the lever. The current adopted Michigan Building Code edition fire protection system Section 907 shall govern over NFPA 72 Fire Alarm Code for mounting heights.
- J. Electrical Trade shall complete the entire fire alarm system in accordance with plans and specifications.
- K. Electrical Trades to install the door plate as part of the door holder installation. Mount the plate to hollow metal door. Do not use thru-bolts. The door

hardware schedule and the specified architectural installation methods for use by the hardware installer shall govern over the door plate described method.

- L. All fire alarm wiring installation that may be required to be installed through non-accessible ceiling spaces, and cannot be installed in conduit or cable tray, free air method will be acceptable for those spaces. Open wiring is acceptable method. Properly secure to ceiling structure, use J hooks or D-rings. The cable shall be plenum rated for this application.
- M. Ceiling mounted fire alarm device locations are shown diagrammatic. The design requirement shall be to install the device centered in the classrooms, corridor, offices, etc. Confirm the location with lighting, speaker, HVAC diffusers, to avoid interferences.
- N. NAC panel(s) require a dedicated 120 volt power source. The Contractor shall be responsible for coordinating NAC panel quantities and locations with their fire alarm vendor and include all power circuit costs in the bid.
- O. Electrical Trades and their respective fire alarm vendor shall field determine the remote duct detector test station location to maintain easy access for the Owner usage. The test station locations are not shown on the drawings.
- P. Contractor shall be responsible to wire tamper switch to the fire alarm panel. Include fire alarm panel points as part of the overall fire alarm panel points.
- Q. Electrical Trades shall complete all of the magnetic door holders as shown and noted on all project documents. Do not rely solely on the electrical plans for the project requirements. The Contractor shall be responsible to review associated architectural documents and include all work.
- R. Electrical Trades shall complete all fire alarm interface wiring to coiling shutter doors, food service fire suppression system connections, at all sprinkler riser locations. Exterior horn/strobe associated with exterior fire protection fire department hose connections/flow and tamper switches.
- S. Fire alarm vendor shall wire elevator smoke detectors to elevator controller.
- T. Electrical Trades shall furnish and install a circuit breaker lock for the 120 volt circuit serving the fire alarm panel. Label the panelboard directory branch circuit text in red.

### 3.2 MANUFACTURERS FIELD SERVICES

- A. The manufacturer shall provide on-site technical for start-up, commissioning, programming, and trouble shooting.
- B. Provide certification that system operates to meet Local and State requirements.
- C. Owner training. Provide (2) 4 hour system training sessions at Owner's facility.

- D. Sound coverage. Fire alarm vendor shall be responsible for proper audibility levels. Include all costs for additional devices, inspection and testing.

3.3 WARRANTY

- A. Provide a one-year guarantee from date of system acceptance by the Owner.

3.4 CLOSE-OUT

- A. Provide O&M manuals, warranty letter, as-built drawings and inspection sign-off.

END OF SECTION

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SECTION 02 41 13.13  
PAVEMENT REMOVAL

PART 1 - GENERAL

1.01 Work Included

This work includes removal of an existing pavement, including streets, driveways, sidewalks, curb and/or gutter, and parking areas. For purposes of the work "pavement removal", pavement material may include HMA, concrete, brick, or any combination thereof, including any reinforcement materials.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Limits of Removal

Pavement shall be removed to the limits shown on the plans, or as directed by the Owner in the field. Where pavement is to be removed to allow for the construction of utilities or other improvements, pavement shall be removed to the limits required for their construction.

3.02 Pavement Removal (Including Curb and Gutter Removal)

Pavement shall be removed to an existing joint or to a sawed joint. An existing crack is not suitable for the limit of removal. Sawed joints for pavement removal are to be either parallel or perpendicular to the longitudinal centerline. Sawed joints shall extend substantially through the full thickness of the pavement so that a "clean break" is made and that the adjacent pavement or structures that are to remain are not damaged. If adjacent pavement or structures that are to remain are damaged as a result of the Contractor's removal operations, they shall be replaced to the Owner's satisfaction at the Contractor's expense.

Curb and gutter removal shall be as directed by the Owner. The Contractor shall sawcut existing curb and/or gutter perpendicular to and completely through the existing concrete.

Broken concrete, HMA, brick, and other debris resulting from pavement removal operations shall become the Contractor's property and disposed of properly.

Where pavements are encountered that are composed of more than one material or multiple courses of the same material, the pavement shall be removed in its entirety and all components shall be considered part of the same pavement area.

The Contractor shall provide sufficient barricades and fences to protect pedestrians and vehicles from hazardous areas.

\*\*\*END OF SECTION\*\*\*

SECTION 31 10 01  
CLEARING AND REMOVAL OF MISCELLANEOUS STRUCTURES

PART 1 - GENERAL

1.01 Work Included

This work includes, but is not limited to, clearing, topsoil removal, tree and stump removal, and the removal and protection of miscellaneous items within the project area.

1.02 Related Work

A. Section 02 41 13.13 – Pavement Removal

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Location of Underground Utilities

The Contractor shall call MISS DIG at least three work days before excavating in an area so that utility companies can identify their buried utilities. The Contractor shall notify area municipalities and other utilities in the area that do not participate in the MISS DIG program for location of their utilities.

3.02 Stripping and Stockpiling of Topsoil

Prior to excavating, the existing topsoil surface shall be stripped and stockpiled from within the limits of the proposed excavation.

3.03 Removal of Fences, Signs, Mailboxes, Ornaments, and Other Objects

Fences, signs, mailboxes, ornaments, and similar objects that fall within the project area shall either be protected or removed. If removed, the materials shall be carefully taken apart and stored in a place where they will not be damaged or stolen.

Where mailboxes are removed, a temporary mailbox shall be installed and maintained by the Contractor until the permanent one is replaced.

Traffic signs shall not be removed unless approved by the agency responsible for them. If approved for removal, traffic signs and posts shall be reinstalled in accordance with the requirements of the agency responsible for them.

If any of the materials to be removed are damaged or badly deteriorated before the Contractor removes them, the Contractor shall notify the Owner before the object is removed. Materials that are damaged, stolen, or lost after they have been removed shall be replaced by the Contractor at no increase in project cost.



#### 3.04 Conflicts with Utility Poles

Where the proposed excavation requires that a pole or guy be supported or temporarily relocated, the Contractor shall make arrangements with the appropriate utility to have the pole or guy supported or relocated. Any costs for this shall be the Contractor's expense.

If the Contractor supports the pole or relocates the guy themselves, the method used shall meet the approval of the appropriate utility. The Contractor shall be solely responsible for any supporting work to the utility company.

#### 3.05 Trees and Brush

Brush lying within the limits of the proposed excavation shall be cleared by the Contractor. Brush shall be removed from the project area and disposed of properly.

Trees lying within the limits of the proposed excavation that are to be removed shall be cut down by the Contractor. Plans may not show all trees of all nature and the Contractor shall become familiar with the project and base their work on their own assessment. The Contractor shall coordinate with the Owner as to which trees are to be left in place and those that will be acceptable to remove. The Contractor shall notify the property owner (or the adjacent property owner if the tree is located in a public right-of-way) in advance of cutting down tree(s). The wood from the tree(s) shall be offered to the landowner. If the landowner wants the wood, the tree shall be cut into sections 8 feet long and stacked adjacent to the project area.

Small branches, limbs, and other debris shall be removed from the area by the Contractor and disposed of properly. If the landowner does not want wood from the trees, all wood including branches, limbs, and other debris shall be removed from the area by the Contractor and disposed of properly.

Stumps shall be removed in their entirety and disposed of away from the project area in an acceptable manner. Burning or burying along the project route is not acceptable.

\*\*\*END OF SECTION\*\*\*

SECTION 31 23 01  
EXCAVATING, FILLING, AND GRADING

PART 1 - GENERAL

1.01 Work Included

The work of excavating, filling, and grading includes, but is not necessarily limited to:

- A. Excavating for footings and foundations;
- B. Filling and backfilling to attain indicated grades;
- C. Trenching and trench backfilling;
- D. Rough and finish grading of the site; and
- E. Furnishing and installing granular cushion under concrete slabs on grade.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- B. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 01 57 26 – Dust Control
- C. Section 02 41 13.13 – Pavement Removal
- D. Section 31 25 00 – Soil Erosion and Sedimentation Control

1.04 Job Conditions

A. Dust Control

Dust caused by the Contractor's operations during performance of the work, or resulting from the condition in which the Contractor leaves the site, shall be controlled by the Contractor. The Contractor shall use all means necessary to control dust on and near the work zone and all off-site borrow areas.

All surfaces shall be thoroughly moistened, as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

B. Protection

The Contractor shall use all means necessary to protect all materials before, during, and after installation and to protect all objects designated to remain.

In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost.

C. Safety

The Contractor is responsible for conducting operations in a safe and orderly manner and in conformance with MIOSHA P.A. 154.

D. Permits

Unless otherwise provided, the Contractor is responsible to obtain and comply with permits required under Parts 31 and 91 of Michigan PA 451 of 1994 (Natural Resources and Environmental Protection Act) and any local ordinances.

## PART 2 - PRODUCTS

### 2.01 Fill Material – General

All fill material shall be subject to the approval of the Owner.

For approval of fill material, notify the Owner at least four working days in advance of intention to import material, designate the proposed borrow area, and permit the Owner to sample, as necessary, from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

### 2.02 Fill, Trench, and Structural Backfill Material

Fill material, unless specified otherwise, shall be soil or soil-rock mixture that is free from organic matter and other deleterious substance. It shall contain no rocks or lumps over 6 inches in greatest dimension and not more than 15 percent of the rocks or lumps shall be larger than 2½ inches in greatest dimension.

Fill material obtained from offsite sources shall meet the requirements of the preceding paragraph and additionally, shall be predominantly granular with a maximum particle size of 2 inches and a plasticity index of 12 or less.

Fill material placed within 2 feet horizontally of the base of building foundations and/or slabs shall have a plasticity index of 15 or less.

### 2.03 Sand

Sand shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 2.04 Granular Cushion

Granular cushion under slabs shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 2.05 Sand for Backfill

Sand shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 2.06 Stone for Pipe Bedding

Stone shall meet the requirements of Series 6AA aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 2.07 Stone for Backfill

Stone shall meet the requirements of 21AA crushed aggregate or 4G open-graded aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 2.08 Flowable Fill

Flowable fill shall be a mixture of Portland cement, fly ash, sand, and water in the following proportions.

| Flowable Fill Mixture Ratios |                         |   |
|------------------------------|-------------------------|---|
| Material                     | Type                    | Quantity  |
| Portland Cement              | Type I or IA            | 50 lb/cyd   |
| Fly Ash                      | ASTM C618, Class C or F | 500 lb/cyd  |
| Sand                         | MDOT 2NS                | 2,850 lb/cyd  |
| Water                        |                         | Approx. 376 lb/cyd<br>(sufficient to produce desired flowability) |

Flowable fill shall be produced and delivered at a minimum temperature of 50 degrees Fahrenheit. Mixtures shall be transported to the point of placement in a revolving drum mixer or agitator.

#### 2.09 Geotextile

Geosynthetics must be composed of long-chain synthetic fiber of at least 85 percent, by weight, polyolefins or polyesters. Geosynthetics must be capable of resisting degradation from chemicals, mildew, rot, and ultraviolet (UV) light.

Geotextile used to prevent intermixing of soft subgrade and subbase materials shall meet the requirements per the Michigan Department of Transportation 2020 Standard Specifications for Construction, as shown in Table 910-1 for geotextile stabilization and separator.

## 2.10 Other Materials

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

## PART 3 - EXECUTION

### 3.01 General

Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this section. The Contractor shall not allow or cause any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests, and approvals. Should any of the work be enclosed or covered up before it has been approved, the Contractor shall uncover all such work at no additional cost to the Owner. After the work has been completely tested, inspected, and approved, the Contractor shall make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Owner.

The Contractor shall excavate ahead of the proposed utility installation to expose any existing buried utilities. If existing utility grades conflict with the proposed utility grade, the proposed utility grade may be adjusted by the Owner, if necessary, to miss the existing utility grade at no additional expense to the contract.

### 3.02 Geotextile Stabilization and Geotextile Separator

Deliver and store geosynthetics in packaging capable of resisting UV radiation, contaminants, and moisture. Label each unit of material with product information, including supplier and lot identification. Do not expose geosynthetics to direct sunlight for prolonged periods. Repair or replace damaged geosynthetics at no additional cost to the project.

#### A. Geotextile Placement

Place or install geotextile products in accordance with the manufacturer's installation guidelines and this subsection.

Do not operate equipment required to place backfill directly on geotextile products. Eliminate wrinkles or waves that develop during placement. Place the products in direct contact with the soil below before placing backfill on the geotextile products.

Shingle-lap longitudinal and transverse joints at least 2 feet, or seam the joints in accordance with the manufacturer's recommendations. Ensure field or factory seams meet the minimum grab tensile strength for the product application. Place seams facing upward for inspection purposes.

Repair tears or damage to the geotextile in accordance with the manufacturer's recommendations.

B. Aggregate or Granular Material Placement

Spread and grade the first layer of aggregate or granular material after placing geotextile to create a stable work platform before compaction. Place additional aggregate or granular material, as required, and compact. Fill ruts with additional aggregate or granular material and compact before placing each subsequent layer. The cost of aggregate or granular material, including additional quantities required to fill ruts, is included in the unit prices for related pay item(s).

3.03 Excavating

Where depressions result from, or have resulted from, the removal of surface or subsurface obstructions, the Contractor shall open the depression and remove all debris and soft material as directed by the Owner.

The Contractor shall excavate to the grades shown on the drawings. Where excavation grades are not shown on the drawings, excavation shall be completed, as required, to accommodate the installation.

All over-excavated areas shall be backfilled and compacted at no additional cost to the Owner.

3.04 Preparation of Subgrade

After the site has been cleared, stripped, and excavated to within 6 inches of the specified depths for recompaction, the exposed surface shall be scarified to a minimum depth of 6 inches, thoroughly moisture-conditioned, and compacted to the requirements specified below for fill.

All ruts, hummocks, and other uneven surfaces shall be removed by surface grading prior to placement of fill.

3.05 Subgrade Undercutting

Subgrade undercutting shall be performed to replace material susceptible to frost heaving, differential frost action, or unstable soil conditions, as determined by the Owner.

After the subgrade has been excavated to the approximate grade, the Owner will inspect the grade to determine if subgrade undercutting is required and to determine the limits of such undercutting. The Contractor shall provide suitable equipment for proof rolling the grade. The inspection, proof rolling, and subgrade undercutting shall be completed prior to placing any embankment, road base, or pavement.

The Contractor shall undercut the subgrade within the limits defined by the Owner. All excavated material resulting from the undercutting shall become the Contractor's property disposed of outside the project limits, unless otherwise directed. The volume of earth removed by subgrade undercutting shall be replaced by suitable soils as follows:

A. Type I Subgrade Undercutting - backfill with selected clay or similar material approved by the Owner.

B. Type II Subgrade Undercutting - backfill with sand.

C. Type III Subgrade Undercutting

Backfill with the material excavated from subgrade undercut areas after mixing the excavated material to break up the undesirable strata of soils or with other Owner-approved backfill material.

D. Type IV Subgrade Undercutting

Backfill with 21AA crushed aggregate or 4G open-graded aggregate. Encapsulate 4G aggregate with geotextile separator.

Backfill material shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

3.06 Excess Water Control

Fill material shall not be placed, spread, or rolled during unfavorable weather conditions. Operations shall not resume until moisture content and fill density are satisfactory to the Owner. Berms or channels shall be provided to prevent flooding of subgrade. All water collecting in depressions shall be promptly removed.

Where soil has been softened or eroded by flooding or placement during unfavorable weather, all damaged areas shall be removed and compacted as specified below for fill and compaction.

The Contractor shall provide suitable means and equipment to maintain excavations and other parts of the work free from water.

Dewatering means and methods shall provide dry excavations and the preservation of the final lines and grades of bottoms of excavations.

3.07 Fill and Compaction

After subgrade compaction has been approved by the Owner, the Contractor shall place approved fill material in layers not exceeding 10 inches in uncompacted thickness.

The fill material shall be watered or aerated, as necessary, and thoroughly mixed to obtain a moisture content that will permit proper compaction.

Each soil layer shall be compacted to at least the specified minimum degree. The filling and compaction process shall be repeated until plan grade is attained.

A. Compaction Requirements

Unless otherwise specified on the drawings or in other sections of the specifications, fill and backfill shall be placed in 8-inch lifts and each lift shall be compacted to not less than the percentages of the maximum density stated in Section 01 45 16.02 – Density and Aggregate Testing.

Compaction by jetting will not be permitted.

### 3.08 Grading

Except as otherwise directed by the Owner, the Contractor shall perform all rough and finish grading required to attain the elevations shown on the drawings.

| Tolerances For Grading             |                         |                                       |                         |
|------------------------------------|-------------------------|---------------------------------------|-------------------------|
| Rough Grade                        |                         | Finish Grade                          |                         |
| Building, roads, and parking areas | Plus or minus 0.1 feet  | Granular cushion under concrete slabs | Plus or minus 0.05 feet |
| Landscaped areas                   | Plus or minus 0.25 feet | Parking areas                         | Plus or minus 0.03 feet |
|                                    |                         | Landscaped areas                      | Plus or minus 0.1 feet  |

After grading is completed and has been accepted by the Owner, the Contractor shall permit no further excavating, filling, or grading.

The Contractor shall use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

### 3.09 Excavating for Footings

Earth surfaces, upon which footings will be placed, shall be compacted in accordance with the compaction requirements established in this section of these specifications.

The Contractor shall verify that all compaction is complete and approved prior to excavating for footings.

The Contractor shall excavate to the required lines and grades. The bottom of trenches shall be cut level and all loose soil shall be removed. Where soft spots are encountered, unsuitable materials shall be removed and replaced with flowable fill at no additional cost to the Owner.

### 3.10 Placing Granular Cushion

The Contractor shall carefully place the specified granular cushion in areas to receive concrete slabs on grade, uniformly attaining the thickness indicated on the drawings, and providing all required transition planes.

### 3.11 Trenching

The Contractor shall perform all trenching required for the installation of items where the trenching is not specifically described in other sections of these specifications.

All trenches shall be open construction, with sufficient width to provide free working space at both sides of the trench and around the installed item as required for pipelaying, backfilling, and compacting.

Trenching shall be completed, as required, to provide the elevations shown on the drawings.



Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 18 inches of fill above the top of the pipe, measured from the adjacent finished grade.

Where trench excavation is inadvertently carried below proper elevations, the over-excavated area shall be backfilled with material approved by the Owner, and then compacted to provide a firm and unyielding subgrade and/or foundation to the approval of the Owner and at no additional cost.

The Contractor shall properly support all trenches in accordance with all applicable rules and regulations.

The Contractor shall brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.

In the event of damage to such improvements, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost.

Bracing, sheeting, and shoring shall be constructed so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength. The Contractor shall exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse and caving of the excavation faces being supported.

Trenched material shall be stockpiled in a manner to prevent water running into the excavations. Surface drainage shall not be obstructed. A means shall be provided whereby storm and wastewaters are diverted into existing gutters, other surface drains, or temporary drains.

### 3.12 Foundation for Pipes

Trench bottoms shall be graded to provide a smooth, firm, and stable foundation free from rock points throughout the length of the pipe.

A minimum of 4 inches of sand or stone bedding shall be placed in the bottom of the trench.

In areas where soft, unstable materials are encountered at the surface where the bedding is to be placed, the unstable material shall be removed and replaced with material approved by the Owner. The area shall be undercut to a sufficient depth to develop a firm foundation for the item being installed. Over excavation and replacement of material shall be the responsibility of the Contractor and shall be completed at no additional cost to the Owner.

At each joint in pipe, the bottom of the trench shall be recessed, as required, to relieve the bell of the pipe of all load and to ensure continuous bearing of the pipe barrel on the firm foundation.

The pipe subgrade shall be shaped to fit the bottom of the trench to the pipe shape.

### 3.13 Bedding for Pipes

The specified bedding shall be placed in the trench, simultaneously on each side of the pipe for the full width of the trench, to a depth of at least 12 inches over the outside diameter of the pipe barrel.

The bedding material shall be compacted after placing along both sides of the pipe.

Firm bedding support on the underside of the pipe and fittings shall be provided for the full length of the pipe.

### 3.14 Backfill for Pipes

After the pipe has been thoroughly bedded and covered, suitable excavated material shall be placed in uniform lifts of not more than 10 inches in uncompacted thickness and then compacted as specified in this section. The spreading and compacting procedure shall be repeated until the adjacent grade level is attained. Backfill material shall be sand when in the influence of structures, pavement, or utilities.

### 3.15 Miscellaneous Pipe Repair

When an existing sewer pipe, drain pipe, field tile, or other existing pipe is damaged as a result of construction activities and is not designated for removal or abandonment on the plans or by the Owner, it shall be repaired by the Contractor.

The section of damaged pipe shall be removed to existing joints or to sawed joints where the existing pipe is sound and undamaged. A length of new pipe of the same size as the original pipe shall be furnished and installed to replace the section of pipe removed. The new pipe may be any one of the following materials:

- A. Same material, class or thicknesses, as the original pipe
- B. PVC Schedule 40, for pipes 8 inches or less in diameter
- C. PVC SDR 26, for pipes 8 inches or greater in diameter
- D. Other pipe material approved by the Owner

Each end of the new section of pipe shall be connected to the remaining sections of existing pipe using a rubber gasketed sleeve, suitable for the pipe materials and sizes being joined, to provide a watertight connection. The repaired section of pipe shall be firmly bedded in sand or stone, compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

\*\*\*END OF SECTION\*\*\*

SECTION 31 23 02  
EXCAVATING AND BACKFILLING FOR UTILITY CONSTRUCTION

PART 1 - GENERAL

1.01 Work Included

This work includes preparation, excavating, bedding, and backfilling for the construction of utilities, pipelines, manholes, and other related appurtenances.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- B. ASTM A139 – Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
- C. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 01 57 26 – Dust Control
- C. Section 02 41 13.13 – Pavement Removal
- D. Section 31 10 01 – Clearing and Removal of Miscellaneous Structures
- E. Section 31 25 00 – Soil Erosion and Sedimentation Control
- F. Section 33 11 00 – Water Main
- G. Section 33 31 00 – Sanitary Sewer
- H. Section 33 44 00 – Storm Sewers

1.04 Submittals

- A. Flowable fill
- B. Design calculations for temporary sheeting, shoring, timbering, and bracing for trenches

1.05 Safety

The Contractor is responsible for conducting operations in a safe and orderly manner and in conformance with MIOSHA P.A. 154.

## 1.06 Notifications

The Contractor shall contact MISS DIG (800-482-7171 or 811) for the location of underground utilities at least three working days in advance of beginning any excavation. The Contractor shall contact utility agencies, which are not part of the MISS DIG system, to arrange for the location of their utilities in advance of beginning excavation.

## PART 2 - PRODUCTS

### 2.01 Trench Backfill

Backfill material, unless specified otherwise, shall be soil or soil-rock mixture which is free from organic matter and other deleterious substance. It shall contain no rocks or lumps over 6 inches in greatest dimension, and not more than 15 percent of the rocks or lumps shall be larger than 2½ inches in greatest dimension. Backfill placed within 12 inches of the proposed pipeline or structures shall be free of any rocks or lumps.

### 2.02 Sand for Bedding or Backfill

Sand shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

### 2.03 Stone for Pipe Bedding

Stone shall meet the requirements of Series 6AA aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

### 2.04 Flowable Fill

Flowable fill shall be a mixture of Portland cement, fly ash, sand, and water in the following proportions.

| Flowable Fill Mixture Ratios |                         |   |
|------------------------------|-------------------------|---|
| Material                     | Type                    | Quantity  |
| Portland Cement              | Type I or IA            | 50 lb/cyd   |
| Fly Ash                      | ASTM C618, Class C or F | 500 lb/cyd  |
| Sand                         | MDOT 2NS                | 2,850 lb/cyd  |
| Water                        |                         | Approx. 376 lb/cyd<br>(sufficient to produce desired flowability) |

Flowable fill shall be produced and delivered at a minimum temperature of 50 degrees Fahrenheit. Mixtures shall be transported to the point of placement in a revolving drum mixer or agitator.

## PART 3 - EXECUTION

### 3.01 Existing Utilities

The location of existing piping and underground utilities, such as gas mains, water mains, electric duct lines, telephone conduits, etc., as shown on the contract drawings, have been determined from the best available information by actual surveys, or furnished and taken from the records of the utility companies and drawings of the existing facilities. However, the Owner does not assume responsibility for the possibility that during construction, utilities other than those shown may be encountered, or that actual location of those shown may be different from the locations designated on the contract drawings.

The location of the proposed pipes and structures shown on the drawings has been selected to limit interference with, or the crossing of, existing utilities. However, where the actual conditions result in interference with the proposed construction, the Owner may make appropriate adjustments to the alignment of the proposed work.

The Contractor shall furnish all labor and tools to either verify and substantiate the record drawing location, or definitely establish the position of the facilities. The actual location of all utilities shall be determined by the Contractor in advance of excavation and pipelaying work to allow sufficient time and space to make adjustments to the alignment of the proposed pipeline or related structures.

### 3.02 Dust Control

Dust caused by the Contractor's operations during performance of the work, or resulting from the condition in which the Contractor leaves the site, shall be controlled by the Contractor. The Contractor shall use all means necessary to control dust on and near the work zone and all off-site borrow areas.

All surfaces shall be thoroughly moistened, as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

### 3.03 Trench Excavation

The Contractor shall excavate open trenches of sufficient width and depth to provide ample room for the proper construction of the proposed pipeline and its appurtenances as shown on the contract drawings, and for removing any material that the Owner may deem unsuitable for foundation.

The trench width at a level of 12 inches over the crown of the pipe shall not be greater than the maximum width shown on the plans. Where the plans do not specifically show limits for the width of the trench, the trench width shall not exceed 30 inches. The trench depth shall be undercut below the proposed grade of the pipeline or structure to allow sufficient space for the required bedding.

The excavation of the trench shall not advance ahead of the completed manhole and pipe work.

Trench excavation includes clearing the site of the work, loosening, loading, removing, transporting, and disposing of all materials necessary to be removed for the construction of the proposed work. Excavation shall be completed to the lines, grades, and locations necessary to complete the work shown on the contract drawings. If encountered within the limits of the excavation, the removal of quicksand; hardpan; boulders; clay; rubbish; unforeseen obstacles; abandoned conduits, pipes, tile, and telephone ducts; tree roots and stumps; masonry structures; railroad tracks; pavements; and sidewalks are included in the work of excavation and will not be paid for separately.

The Contractor shall coordinate with the owners or users of any poles, pipes, tracks, or conduits, or other systems that might be affected by the construction of the project, to maintain and protect such facilities during construction. Any costs for protecting, maintaining, or restoring these systems will be the Contractor's responsibility, and not paid for separately.

Excavated material shall not be placed outside the limits of the public right-of-way or the limits of easements for the utility. Excavated material shall not be placed on adjacent lawn areas, unless there is no other suitable place to put it. Excavated material shall be placed on pavements or sidewalks, only if approved by the Owner.

Sidewalks and pavements shall not be blocked or obstructed by excavated material, except on the authorization of the Owner. Adequate provisions shall be made for the safe temporary passage of pedestrians and vehicles. Adequate bridging and planked crossings shall be provided and maintained across all open trenches for pedestrians and vehicles.

The Contractor shall provide all temporary sheeting, shoring, timbering, and bracing required to maintain the excavation in a condition to furnish safe working conditions and to permit the safe and efficient installation of all items of contract work. Shoring and supports shall be designed by a licensed Owner. The Contractor shall shore up, or otherwise protect all fences, shrubs, buildings, walls, walks, curbs, or other property adjacent to any excavation which might be disturbed during the progress of the work.

Sheeting and bracing shall be removed as the work progresses, in such a manner as to prevent the caving in of the excavations, or any damage to the project. All voids resulting from the removal of sheeting and bracing shall be carefully filled with fine sand and rammed to eliminate voids and prevent future settlement.

The contract price in this contract shall include the cost of all temporary supports and braces that may be necessary to secure a safe prosecution of the work until the permanent structure is complete.

Whenever the excavation is carried beyond the lines and grades shown on the contract drawings or given by the Owner, the Contractor shall, at their own expense, refill all such excavated space with stone material or flowable fill in such a manner as may be directed.

Excavated material shall be deposited so as to interfere as little as possible with the excavation of the whole work. Unsuitable and surplus excavated material, not incorporated in the improvement, shall be disposed of by the Contractor at their own expense, unless otherwise designated.

If private land is used by the Contractor as a spoil site, the Contractor shall obtain written permission from the owner or agent of the land agreeing to its use for this purpose and provide the project Owner with a certified copy of such agreement.

Excavated material that is suitable for backfill and is planned to be used for backfill, shall be neatly piled adjacent to the excavation so as to prevent cave-ins of the excavation and damage to adjacent trees, shrubs, fences, and other property.

The excavated area shall be kept free of water at all times. The Contractor shall furnish and maintain any wells, pumps, or other measures needed to provide a dry, stable trench for pipelaying. Sheet piling and shoring shall be provided, if necessary, for the protection of the workers.

Backfilling shall follow immediately behind trench excavation and pipelaying operations. In no case shall more than 100 feet of trench excavation be open at any one time. Any excavation left open and unattended shall be protected with lighted barricades and a "snow fence" constructed around the perimeter of the excavation.

The Contractor shall excavate to the depths required to construct the water main and appurtenances as described on the plans. For water main construction, trench excavation shall be to a depth as shown on the plans and a 4-inch sand cushion below the pipe. The trench width at a level of 12 inches above the pipe shall be no greater than the pipe diameter plus 24 inches.

In areas where the proposed construction may interfere with existing utilities, additional excavation may be required to determine the exact location of said existing utilities. This work will be included in the other pay items and no additional compensation will be due to the Contractor for this work.

#### 3.04 Bedding

Pipe bedding shall be a 4-inch sand cushion, unless shown otherwise on the drawings.

The pipe bedding shall be shaped to match the bottom ¼ of the pipe's shape. The bedding shall be excavated to accommodate the pipe bells. The completed bedding shall provide uniform support of the entire length of pipe.

#### 3.05 Dewatering

The excavation shall be maintained free of water (including groundwater, surface water, storm runoff, or sanitary wastewater) during the performance of the work.

The Contractor shall provide such dewatering as may be necessary to keep the excavation free of water, including ditching, pumping, wells, well pointing, or bailing. All water removed by the Contractor's dewatering operations shall be discharged without damage to adjacent properties.

Necessary precautions shall be taken to protect all construction against flooding.

The Contractor shall supply water to home owners if wells go dry due to construction. Any

damage to neighboring wells caused by dewatering efforts shall be repaired by the Contractor at the Contractor's expense.

### 3.06 Structure Excavation

Excavation for manholes or special structures shall be made to the depth and dimensions necessary for the proper installations of all structures shown on the contract drawings. Care shall be taken that the foundation area of the structure is not excavated below grade, except when rock is encountered. Where masonry is built directly against the sides or bottom of the excavations, the final trimming shall be done just before the masonry is placed.

### 3.07 Rock Excavation

Excavation includes the removal of rock.

### 3.08 Foundations, Strengthening

Whenever the ground is sufficiently firm and unyielding, the masonry shall be laid directly on the sand or crushed stone bedding of the excavation and pipes or conduits shall be laid as specified.

When so designated on the contract drawings, or directed by the Owner, excavated areas shall be strengthened for foundation purposes by furnishing and placing crushed rock or gravel refill, flowable fill, concrete cradle or encasement, timber cradles, timber piling, or a combination of these materials.

After the excavation is opened and to grade, it will be examined by the Owner who will determine whether or not it is a satisfactory foundation for masonry or pipes, or if it is necessary to stabilize the base. Where directed by the Owner, a soil load test shall be made to determine the safe bearing capacity of the ground.

### 3.09 Backfill

Unless otherwise directed, all trenches and excavation shall be backfilled as the pipe is laid. No pipes shall be backfilled until the sewer elevations, gradient, alignment, and the pipe joints have been observed by the Owner.

The trench shall be backfilled to the proposed final elevations with suitable materials. Unless other compaction methods are demonstrated and approved by the Owner, backfill shall be placed in 8-inch lifts and compacted to the required density as stated in Section 01 45 16.02 – Density and Aggregate Testing.

In areas which are not to be restored with a pavement or aggregate surface, the backfill shall be graded to a height slightly above the adjacent surface. When final restoration of the area is completed by the Contractor, the backfill surface shall be excavated (or filled if settlement has occurred), trimmed, or graded, as necessary, to provide for the required depth of topsoil and its transition to adjacent, undisturbed areas.



The Contractor shall correct any areas where the trench backfill settles by adding fill, topsoil, and re-seeding.

### 3.10 Miscellaneous Pipe Repair

When an existing sewer pipe, drain pipe, field tile, or other existing pipe is damaged as a result of construction activities and is not designated for removal or abandonment on the plans or by the Owner, it shall be repaired by the Contractor.

The section of damaged pipe shall be removed to existing joints or to sawed joints where the existing pipe is sound and undamaged. A length of new pipe of the same size as the original pipe shall be furnished and installed to replace the section of pipe removed. The new pipe may be any one of the following materials:

- A. Same material, class or thicknesses, as the original pipe
- B. PVC Schedule 40, for pipes 8 inches or less in diameter
- C. PVC SDR 26, for pipes 8 inches or greater in diameter
- D. Other pipe material approved by the Owner

Each end of the new section of pipe shall be connected to the remaining sections of existing pipe using a rubber gasketed sleeve, suitable for the pipe materials and sizes being joined, to provide a watertight connection. The repaired section of pipe shall be firmly bedded in sand or stone, compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

\*\*\*END OF SECTION\*\*\*

SECTION 31 25 00  
SOIL EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 Work Included

The Contractor shall provide permanent and/or temporary erosion and sedimentation control as called for on the plans and as required by the county soil erosion agent and permit.

1.02 Definitions

- A. Major rainfall event – ¼-inch or more precipitation over a period, delineated by dry periods of at least 24 hours.

1.03 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- B. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- C. ASTM D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity
- D. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- E. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- F. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
- G. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- H. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.04 Related Work

- A. Section 01 57 26 – Dust Control
- B. Section 31 37 00 – Riprap
- C. Section 32 92 00 – Turf Establishment

1.05 Permit

The Contractor shall apply for and obtain an Act 451 permit from the local Soil Erosion and Sedimentation Control Enforcing Agent. The Contractor shall pay all permit fees and provide any required bonds or insurance.

#### 1.06 Scheduling

- A. Control measures shall be constructed by the Contractor prior to the time construction starts uphill or upstream from the control measure location.
- B. The Contractor shall inspect all temporary erosion control measures weekly and within 18 hours of major rainfall events.
- C. Maintenance and replacement of erosion control measures shall be completed by the Contractor when necessary, or as directed by the soil erosion control agent or the Owner.
- D. Removal and cleanup of temporary control structures shall be provided by the Contractor within one week after the control measure is no longer needed.

#### 1.07 General Soil Erosion and Sedimentation Control Procedures

- A. Keep disturbed areas small.
- B. Stabilize and protect disturbed areas as soon as possible.
- C. Keep storm water runoff velocities low.
- D. Protect disturbed areas from runoff.
- E. Retain sediment within the construction area.

### PART 2 - PRODUCTS

#### 2.01 Materials

##### A. Geotextiles

Geotextiles for filters shall be non-woven, meeting the requirements of the table below.

Silt fence geotextiles shall meet the requirements of the following table and shall be designed to collect eroded sediment transported in storm water runoff. The fabric shall have at least 70 percent minimum retained strength after 500 hours of U.V. exposure when tested according to ASTM D4355.

| <b>Geotextile Category</b>  | <b>Property/Test Method</b>                       |   |   |   |   |   |
|---|---|---|---|---|---|---|
|   | <b>Grab Tensile Strength (min) ASTM D4632 lbs</b> | <b>Trapezoid Tear Strength (min) ASTM D4533 lbs</b> | <b>Puncture Strength (min) ASTM D4833 lbs</b> | <b>Mullen burst strength (min) ASTM D3786 psi (a)</b> | <b>Permittivity ASTM D4491 Per second</b> | <b>Apparent Opening Size (max) ASTM D4751 (b) Millimeters</b> |
| Filters   | 90  | 45  | 45  | 140   | 0.5                                       | 0.21  |
| Silt Fence  | 100(c)  | 45  | --  | --  | 0.1                                       | 0.60  |
| (a) ASTM D3786. The fluid displacement rate for the Mullen burst test equipment must be 170± 5 ml/minute. Subtract tare strength from the ultimate burst strength as specified by ASTM.<br>(b) Filtration opening size (FOS, Canadian General Standards Board, method 148.1 No. 10) is permitted as an alternate test method to ASTM D4751 for non-woven geotextiles.<br>(c) Elongation at the specified grab tensile strength not to exceed 40 percent for silt fence. |   |   |   |   |   |   |

**B. Stone**

Unless otherwise directed, stone shall meet the requirements of Series 6AA as specified in Michigan Department of Transportation 2020 Standard Specifications for Construction.

**2.02 Mixtures**

**A. Seed**

Seed shall meet the requirements of Section 32 92 00 – Turf Establishment.

**2.03 Fabricated Items**

**A. Silt Fence**

Geotextile for silt fences shall meet the requirements of Section 2.01. The geotextile shall be attached to machine pointed No. 2 common grade hardwood posts, using at least 5 staples through wood lath a minimum of  $\frac{3}{8}$ -inch thick and 2 feet long. Post spacing shall not exceed  $6\frac{1}{2}$  feet. Posts must be of sufficient length and cross-section to support the installed silt fence under full sediment load; however, posts shall have cross-sectional area of at least  $2\frac{1}{4}$  square inches and shall be a minimum of 36 inches in length. Silt fence fabric must be a minimum height of  $2\frac{1}{2}$  feet. Silt fence shall have at least two permanent markings or affixed labels per assembled roll which positively identifies the fabricator.

**B. Mulch Blankets**

Mulch blankets shall meet the requirements of Section 32 92 00 – Turf Establishment.

**C. Filter Sacks**

All materials shall adhere to the requirements of the Michigan Department of Transportation 2020 Standard Specifications for Construction, except fabric drop, which shall consist of a geotextile filter sack inserted into the drainage structure under the cover.

Filter sack shall be as manufactured by “Siltsack”, “Catch-All”, “Ultra-Urban Filter”, “Flogard + Plus”, or approved equal. The filter sacks shall be installed and maintained in accordance with the manufacturer’s specifications.

## PART 3 - EXECUTION

### 3.01 General Requirements

The Contractor shall perform work on the project in a manner which prevents or reduces erosion and controls sedimentation. The Contractor shall provide controls which keep sedimentation from the project area, within the limits of the project area, and out of any lake, river, stream, wetland, or storm drain.

The Contractor shall install appropriate controls or measures to control or prevent erosion or sedimentation from the project area before beginning any earth disturbance operations. Temporary erosion and sedimentation control measures shall be maintained by the Contractor, until such times as disturbed areas have become permanently stabilized.

During the life of the project, the Contractor shall provide any additional soil erosion or sedimentation control measures necessary to address specific problems which develop in and adjacent to the project area.

### 3.02 Time Limitations

Grading operations shall be completed as soon as practical. Permanent soil erosion controls for disturbed areas shall be completed within 5 calendar days of the completion of grading, except that permanent measures shall be completed within 24 hours when the disturbed area is within 150 feet of a lake, stream, river, or wetland area.

Temporary soil erosion measures shall be implemented when it is not practical to complete the permanent measures.

### 3.03 Area Limitations

For linear projects (roads, sewers, water main, etc.), the length of the disturbed area shall be limited to ½-mile, unless otherwise approved by the Owner.

Areas outside the project right-of-way or outside the grading limits shown on the drawings shall not be disturbed, unless otherwise approved by the Owner.

### 3.04 Construction of Erosion and Sedimentation Controls

The Contractor shall provide all permanent and temporary erosion and sedimentation controls shown on the drawings, required by the permitting agency, or necessary to appropriately control erosion and sedimentation from the project area.

#### A. Check Dams

Check dams shall be installed and maintained across ditches and watercourses, which might convey surface runoff from disturbed areas within the project area, or where shown on the drawings or required by the Owner or permitting agency.

B. Silt Fence

The Contractor shall furnish, erect, and maintain silt fence around the perimeter of the project area where earth will be disturbed and sediment from the disturbed area could be conveyed.

C. Filters

Fabric or stone filters shall be installed in waterways or in advance of inlets to drainage courses or storm sewers.

D. Sediment Traps and Basins

Sediment traps shall be excavated upstream of check dams and where shown on the drawings or directed by the Owner or permitting agency. Check dams shall be installed downstream of the sediment traps and basins prior to the sediment traps and basins being excavated.

E. Seeding

Earth areas shall be stabilized with turf immediately following the completion of earthwork and grading activities. Where permanent seeding cannot be completed, earth areas shall be stabilized with temporary seeding. Areas which are properly seeded temporarily for stabilization shall be permanently seeded, as shown, as the work can be appropriately completed.

F. Mulch Blankets

Areas susceptible to erosion from moving water, which are not to be paved, shall be seeded and protected with high velocity mulch blankets.

3.05 Maintenance and Erosion and Sedimentation Control

The Contractor shall maintain all temporary erosion and sedimentation controls until such time as the permanent measures have been completed and established.

The Contractor shall inspect all erosion and sedimentation controls weekly and within 18 hours of a major rain event.

Damaged controls or measures shall be replaced or repaired. Sediment shall be cleaned from traps, sumps, basins, filters, and fences periodically. Sediment shall be removed to prevent the accumulation of sediment from exceeding half of the volume of traps, sumps, and basins. Sediment or debris along silt fences shall be removed before the accumulation reaches half the height of the fence.

Sediment and debris removed from soil erosion and sedimentation control devices shall be disposed of properly by the Contractor. Sediment shall not be used for fill or backfill in the project area, except when an area is specifically designated on the plans or by the Owner.

Drainage filters shall be cleaned when an accumulation of silt might reduce flow and result in flooding.

Any sediment from the construction area which enters storm sewers or drainage ditches shall be removed by the Contractor. Since sediment can be carried great distances within storm sewers, it may be necessary for many segments of downstream storm sewer segments to be televised,

jettied, and vacuumed. If the Owner believes that the Contractor has allowed or provided the potential for sediment to enter storm sewers or drainage courses, the Contractor will be responsible for the costs of inspection and removing sediment from downstream drains, whether it can be conclusively proven that the sediment was the result of the Contractor's actions (or inaction).

### 3.06 Removal of Erosion and Sedimentation Control Devices

Temporary soil erosion and sedimentation control devices shall be removed or obliterated by the Contractor when the permanent measures are in place and established. Any areas damaged by the removal of the temporary devices shall be corrected by the Contractor.

Mulch used for temporary erosion control may either be removed or worked into the soil before the permanent topsoil and seeding is completed.

\*\*\*END OF SECTION\*\*\*

SECTION 31 37 00  
RIPRAP

PART 1 - GENERAL

1.01 Work Included

This work includes providing slope or erosion protection where shown on the drawings or where directed by the Owner. This work includes all necessary excavation and disposal of excavated material. A protective riprap covering of the type shown on plans shall be constructed on a prepared foundation, including headers along the edges of the slope protection, when specified. Unless otherwise noted, all riprap shall be installed over a geotextile liner. Slope protection may be of the following types:

- A. Plain Riprap

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. ASTM A996 – Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- C. ASTM C94 – Standard Specification for Ready-Mixed Concrete
- D. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- E. ASTM D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity
- F. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- G. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- H. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
- I. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- J. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 31 25 00 – Soil Erosion and Sedimentation Control



## PART 2 - PRODUCTS

### 2.01 Materials

#### A. Cement

Cement shall meet the requirements of ASTM C94.

#### B. Steel Reinforcement

Steel reinforcement shall be deformed bars meeting the requirements of ASTM A615 or ASTM A996, at the Contractor's option.

#### C. Plain Riprap

Stone for plain riprap shall be sound, tough, durable broken rock, free from structural defects or solid precast concrete blocks. Sound pieces of broken concrete may be used in place of stone when approved by the Owner. Individual stones or pieces of broken concrete shall measure at least 8 inches in 1 dimension and shall have a volume of not less than  $\frac{1}{3}$  cubic foot, except that smaller pieces may be used for filling spaces between the riprap stone. Broken concrete with projecting reinforcement or rounded boulders or cobblestones shall not be used.

#### D. Geotextile Liner

Geotextile material shall be non-woven, and designed for use for erosion control with riprap or similar applications.

Geotextile fabric shall meet the following physical requirements:

| <b>Physical Property</b>          | <b>Test Method</b> | <b>Requirements for Riprap (except heavy)</b> | <b>Requirements for Heavy Riprap</b> |
|-----------------------------------|--------------------|---|--------------------------------------|
| Grab Tensile Strength (minimum)   | ASTM D4632         | 200 pounds                                    | 270 pounds                           |
| Trapezoid Tear Strength (minimum) | ASTM D4533         | 75 pounds                                     | 100 pounds                           |
| Puncture Strength (minimum)       | ASTM D4833         | 75 pounds                                     | 100 pounds                           |
| Mullen Burst Strength (minimum)   | ASTM D3786         | 200 pounds                                    | 400 pounds                           |
| Permittivity                      | ASTM D4491         | 0.5 per second                                | 0.5 per second                       |
| Apparent Opening Size (maximum)   | ASTM D4751         | 0.21 mm                                       | 0.21 mm                              |

#### E. Fine Aggregate

Fine aggregate for mortar mixtures shall meet the requirements of 2NS fine aggregate, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

## PART 3 - EXECUTION

### 3.01 Preparation of Subgrade for Slope Protection

The subgrade shall be formed by trenching or filling to the required elevation for the bottom of riprap. The subgrade shall be thoroughly tamped or otherwise compacted to ensure its stability

and trimmed to the necessary tolerances. The subgrade shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

### 3.02 Plain Riprap

The bank on which the plain riprap is to be placed shall be trimmed to a uniform slope, as shown on the plans. A geotextile liner shall be installed on the subgrade.

The riprap shall commence in a trench below the toe of the slope, and shall progress upward, with each stone being laid by hand and firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope, with the surfaces in contact and with well broken joints. The riprap shall be thoroughly compacted as the construction progresses, and the finished surface of the riprap shall present an even, tight surface. The thickness of the riprap, other than precast concrete blocks, shall not be less than 10 inches, measured perpendicular to the slope. Individual stones shall be laid with their 10 inch minimum dimensions perpendicular to the plane of the surface to be riprapped.

When completed, the geotextile liner shall not be visible.

\*\*\*END OF SECTION\*\*\*

SECTION 32 11 16  
GRANULAR SUBBASE

PART 1 - GENERAL

1.01 Work Included

This specification describes the requirements for constructing granular subbase under a proposed aggregate surface.

1.02 References

A. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

A. Section 01 45 16.02 – Density and Aggregate Testing

PART 2 - PRODUCTS

2.01 Materials

A. Granular subbase shall meet the requirements of Class II Sand, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction, unless otherwise noted on the plans, proposal, or specifications.

PART 3 - EXECUTION

3.01 Subgrade Preparation

Granular subbase shall not be placed until the subgrade is properly prepared. The subgrade shall be graded to the required elevations and shape for placement of the specified granular subbase thickness. The subgrade shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Soft or yielding spots shall be excavated and replaced with sound material.

3.02 Placement

Granular subbase shall be placed in a manner that provides a uniform cross section of the specified thickness and the required surface grades. The edges of the area of granular subbase shall be straight and uniform.

Material shall not be placed over frozen, soft, unstable, or rutted subgrade.

Granular subbase shall be placed in lifts not exceeding 12 inches (loose measure) and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

\*\*\*END OF SECTION\*\*\*

SECTION 32 11 23  
AGGREGATE BASE

PART 1 - GENERAL

1.01 Work Included

This specification describes the requirements for constructing an aggregate base under a proposed pavement surface.

1.02 References

A. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

A. Section 01 45 16.02 – Density and Aggregate Testing

PART 2 - PRODUCTS

2.01 Materials

A. Aggregate shall meet the requirements of Series 21AA aggregate, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction, unless otherwise noted on the plans, proposal, or specifications.

PART 3 - EXECUTION

3.01 Subgrade Preparation

Aggregate shall not be placed until the subgrade is properly prepared. The subgrade shall be graded to the required elevations and shape for placement of the specified aggregate thickness. The subgrade shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Soft or yielding spots shall be excavated and replaced with sound material.

3.02 Placement

Aggregate shall be placed in a manner that provides a uniform cross section of the specified thickness and the required surface grades. The edges of the area of aggregate surface shall be straight and uniform.

Aggregate shall be placed in lifts not exceeding 8 inches (loose measure) and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

\*\*\*END OF SECTION\*\*\*

SECTION 32 11 26  
HMA BASE CRUSHING AND SHAPING

PART 1 - GENERAL

1.01 Work Included

The work includes constructing a new aggregate base from an existing Hot Mix Asphalt (HMA) pavement.

1.02 References

A. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

A. Section 01 45 16.02 – Density and Aggregate Testing

B. Section 32 11 23 – Aggregate Base

C. Section 32 12 16 – HMA Paving

1.04 Quality Assurance and Quality Control

A. Acceptance Criteria

The following criteria will be used to determine acceptance of the crush and shape work.

1. The crushed material shall meet the requirements specified for particle size.
2. After final shaping, the variance between the surface and a 10-foot straight edge (any 2 contact points with the surface) does not exceed ½-inch.
3. There are no undulations or variations from the criteria specified just prior to paving.
4. The required density has been maintained until placement of the HMA surface material.

PART 2 - PRODUCTS

2.01 Materials

A. Stabilizer

Stabilizer shall be an anionic emulsified asphalt meeting the requirements of MS-2S, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction, or other material approved by the Owner.

PART 3 - EXECUTION

3.01 Construction

The existing HMA pavement shall be crushed to the limits shown on the plans or directed by the Owner.

### 3.02 Equipment

The Contractor shall use a self-propelled rotary reduction crushing machine that is capable of crushing the HMA pavement to the required dimensions and depth, and mix the crushed material with the underlying aggregate base to the required depth.

A sprinkling system shall be provided for suppression of dust resulting from crushing operations.

Grading equipment shall be equipped with automatic cross slope (crown) control and an automated grade referencing system for longitudinal control.

Pressure distributors shall be equipped with a ground speed control device interconnected with an asphalt emulsion pump, with the ability to deliver at the specified application rate, within +/- 0.015 gallons per square yard. The pressure distributor shall be equipped to deliver asphalt emulsions at the specified temperature. The pressure distributor shall be equipped with an adjustable spray bar that produces a fan spray. The shutoff shall be instantaneous and drip tight.

### 3.03 Crushing and Grading

Unless otherwise provided, the longitudinal crushed grade shall be referenced to either the existing pavement surface or the new HMA pavement surface.

The existing HMA pavement, including 1 or 2 inches of the underlying aggregate base, shall be crushed within the limits shown on the plans or directed by the Owner. Ninety-five percent of the crushed material shall have a maximum particle size of  $1\frac{1}{2}$  inches, with no particle size greater than 4 inches.

The crushed material shall be uniformly spread and compacted to the dimensions shown on the plans. Where additional material is necessary to attain the required grade or cross section, it may be crushed material salvaged from other areas, if available, or shall be a dense graded aggregate. The additional material shall be spread uniformly on the HMA surface before crushing, or uniformly on the crushed surface then remixed with the full depth of crushed material to obtain a uniform mixture.

A stabilizer shall be added to the crushed material at a rate of  $2\frac{1}{2}$  to 3 gallons per square yard of the pavement base.

### 3.04 Compacting and Shaping

The crushed material shall be compacted, at a moisture content not greater than optimum, according to Section 01 45 16.02 – Density and Aggregate Testing.

### 3.05 Weather and Seasonal Limitations

Crushing shall not be performed during wet weather or when precipitation is anticipated. Crushing shall not be performed prior to May 15, nor later than November 1.

\*\*\*END OF SECTION\*\*\*

SECTION 32 12 16  
HMA PAVING

PART 1 - GENERAL

1.01 Work Included

This work includes preparation for and construction of one or more courses of plant mixed Hot Mix Asphalt (HMA).

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Testing Methods (MTM)
- C. Michigan Department of Transportation HMA Production Manual

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 32 11 23 – Aggregate Base

1.04 Quality Assurance and Quality Control

- A. The Owner's Representative will take 20,000 gram samples of the HMA mixture using the mini-stockpile method. The rate of sampling will be determined by the Owner.

PART 2 - PRODUCTS

2.01 Submittals

The Contractor shall submit material source and mix designs to the Owner for approval prior to the start of construction.

2.02 Mixtures

Materials shall meet the requirements of Section 501.02 of the Michigan Department of Transportation 2020 Standard Specifications for Construction. If milling, the mix design to initially cover the milled surface must be approved prior to milling operations.

Furnish HMA mixture, designed using Marshall Mixture Design Methods, in accordance with Section 501 of the Michigan Department of Transportation 2020 Standard Specification for Construction, except as modified by this specification.

Submit the mix design for evaluation in accordance with the Michigan Department of Transportation HMA Product Manual.

Use a 50 blow Marshall hammer when compacting mixtures for developing Marshall mix designs.

Substituting Reclaimed Asphalt Pavement (RAP) for a portion of the new material required to produce HMA mixture is allowed, provided that the mixture is designed and produced to meet all criteria specified herein, unless otherwise prohibited. RAP materials must be in accordance with the standard specifications.

The Mix Design Criteria and Volumetric Properties table provides the mix design criteria and volumetric properties. The Aggregate Properties table provides the required aggregate properties. Use aggregates of the highest quality available to meet the minimum specifications. Use the mixture designation number shown in the contract item name when determining mix design properties from the Mix Design Criteria and Volumetric Properties and Aggregate Properties tables below.

| <b>Mix Design Criteria and Volumetric Properties</b>   |                    |           |           |            |            |
|--|--------------------|-----------|-----------|------------|------------|
|  | <b>Mixture No.</b> |           |           |            |            |
|  | <b>2C</b>          | <b>3C</b> | <b>4C</b> | <b>13A</b> | <b>36A</b> |
| Target Air Void, % (a)   | 3                  | 4         | 4         | 4          | 4          |
| VMA (min) (b)  | 11                 | 13        | 14        | 14         | 15         |
| VFA  | 65-78              | 65-78     | 65-78     | 65-78      | 65-78      |
| Fines to Binder Ratio (max) (c)  | 1.2                | 1.2       | 1.2       | 1.2        | 1.2        |
| Flow (0.01 inch)   | 8-16               | 8-16      | 8-16      | 8-16       | 8-16       |
| Stability (min), lbs   | 1,200              | 1,200     | 1,200     | 900        | 900        |
| (a) Lower target air voids by 1 percent if used in a separate shoulder paving operation. Consider reducing air void targets to 3 percent for lower traffic volume roadways when designing 13A and 36A mixtures for local agency use. |                    |           |           |            |            |
| (b) VMA calculated using Gsb of the combined aggregates.   |                    |           |           |            |            |
| (c) Ratio of the weight of aggregate passing the No. 200 sieve to total asphalt binder content by weight; including fines and binder contributed by RAP.   |                    |           |           |            |            |

| <b>Aggregate Properties</b> |  |           |           |            |            |
|-----------------------------|--|-----------|-----------|------------|------------|
|                             | <b>Mixture No.</b>                                       |           |           |            |            |
|                             | <b>2C</b>  | <b>3C</b> | <b>4C</b> | <b>13A</b> | <b>36A</b> |
|                             | <b>Percent Passing Indicated Sieve or Property Limit</b> |           |           |            |            |
| 1½ inch                     | 100  |           |           |            |            |
| 1 inch                      | 91-100   | 100       |           |            |            |
| ¾ inch                      | 90 max.  | 91-100    | 100       | 100        |            |
| ½ inch                      | 78 max.  | 90 max.   | 91-100    | 75-95      | 100        |
| ⅜ inch                      | 70 max.  | 77 max.   | 90 max.   | 60-90      | 92-100     |
| No. 4                       | 52 max.  | 57 max.   | 67 max.   | 45-80      | 65-90      |
| No. 8                       | 15-40  | 15-45     | 15-52     | 30-65      | 55-75      |
| No. 16                      | 30 max.  | 33 max.   | 37 max.   | 20-50      |            |
| No. 30                      | 22 max.  | 25 max.   | 27 max.   | 15-40      | 25-45      |
| No. 50                      | 17 max.  | 19 max.   | 20 max.   | 10-25      |            |
| No. 100                     | 15 max.  | 15 max.   | 15 max.   | 5-15       |            |
| No. 200                     | 3-6  | 3-6       | 3-6       | 3-6        | 3-10       |
| Crushed (min). % (MTM 117)  | 90   | 90        | 90        | 25         | 60         |



| <b>Aggregate Properties</b>  |                    |           |           |            |            |
|--|--------------------|-----------|-----------|------------|------------|
|  | <b>Mixture No.</b> |           |           |            |            |
|  | <b>2C</b>          | <b>3C</b> | <b>4C</b> | <b>13A</b> | <b>36A</b> |
| Soft Particle (max), % (a)   | 12                 | 12        | 8         | 8          | 8          |
| Angularity Index (min) (b)   | 4                  | 4         | 4         | 2½         | 3          |
| L. A. Abrasion (max), % loss (c)   | 40                 | 40        | 40        | 40         | 40         |
| Sand Ratio (max) (d)   | -                  | -         | -         | 50         | 50         |
| <p>(a) The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 8 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 12 percent for aggregates used in base and leveling courses.</p> <p>(b) The fine aggregate angularity of blended aggregates, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by the virgin material. NAA fine aggregate angularity must be reported for information only and must include the fine material contributed by RAP if present in the mixture.</p> <p>(c) Los Angeles abrasion maximum loss must be met for the composite mixture, however, each individual aggregate must be less than 50.</p> <p>(d) Sand ratio for 13A and 36A no more than 50 percent of the material passing the No. 4 sieve is allowed to pass the No. 30 Sieve.</p> |                    |           |           |            |            |

HMA mixtures and application rates shall be as shown on the plans.

Reclaimed Asphalt Pavement (RAP) shall be limited to 0 percent to 17 percent RAP by weight of the total binder in the mixture. No binder grade adjustment is made to compensate for the stiffness of the asphalt binder in the RAP.

Reclaimed Asphalt Shingles (RAS) will not be allowed in the mixture.

Oil bottoms/recycled motor oil will not be allowed in the mixture.

### PART 3 - EXECUTION

#### 3.01 Equipment

Equipment shall meet the requirements of Section 501.03 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### 3.02 HMA Sampling and Testing

The Contractor shall submit to the Owner for approval the rate at which the HMA will be sampled. Samples will be obtained using the "Mini-stockpile" method in accordance with MTM 324.

Quantitative Extraction of Bitumen from HMA Paving Mixtures (MTM 325) will be used to determine the asphalt content of the HMA mixture.

The Contractor is responsible for HMA testing.

The Contractor shall submit test results to the Owner within seven days of HMA placement.

At the Owner's discretion, original samples of asphalt binder will be taken by the Contractor and delivered to the Owner prior to incorporation into the mixture. The frequency of sampling will be determined by the Owner. The cost of obtaining and delivering the samples to the Owner will be included in the HMA pay item(s). The Contractor must certify, in writing, that the materials used in the HMA mixture are from the same source as the materials used in developing the HMA mixture design and the bond coat is from an approved supplier, as stated in the Material Quality Assurance Procedures Manual.

### 3.03 Preparation

#### A. Aggregate Base (for Pavements Constructed on an Aggregate Base)

See Section 32 11 23 – Aggregate Base.

#### B. Existing Pavement (for Overlays)

Existing castings (drainage structures, manholes, monument boxes, water shutoffs, etc.) shall be temporarily lowered.

The existing pavement surface shall be thoroughly cleaned of all dirt and debris. Loose material shall be removed from all joints and cracks using compressed air, or other suitable means that does not damage the existing pavement.

The existing pavement surface shall be observed by the Owner prior to placement of a bond coat or HMA.

#### C. Removal of Existing Pavement Surface

##### 1. Butt Joints

When a butt joint is to be provided, the existing HMA surface shall be removed to a thickness equal to the thickness of the proposed overlay, for the full width of the butt joint, where the overlay is to meet the existing pavement surface. The depth of pavement removal shall be uniformly tapered from the full depth of the overlay at the butt joint to zero, at a rate of 1-inch per 10 feet.

##### 2. Edge Trimming

Where the edge of an existing HMA pavement is required, the HMA pavement shall be cut its full depth in a manner that provides a vertical, straight edge.

##### 3. Cold Milling

Cold milling shall be performed only when the Contractor is prepared to commence subsequent operations, such as pavement repair and HMA placement, and completes these subsequent operations expeditiously.

The HMA surface shall be removed to the required depth, width, grade, and cross section. The surface shall be removed to the limits shown on the plans, or as directed by the Owner.

Where the HMA surface is removed below the limits specified, the Contractor shall fill and compact the area removed so that the remaining surface is at the proper level. The work to restore the pavement to the required level will be at the Contractor's expense.

After cold milling, and before placement of a new surface, the pavement shall be thoroughly cleaned.

D. Hand Patching

When hand patching is called for on the plans or directed by the Owner, the Contractor shall fill holes, depressions, joints and cracks, and areas to be repaired in an existing pavement. HMA material used for hand patching may be any HMA material approved for use as a top course. A bond coat shall be applied to the exposed pavement surfaces within the area to be patched. The HMA material shall be placed in lifts to the level of the surface of the adjacent existing pavement surface. Each lift shall be within the minimum and maximum thickness range allowed for the mix design, and shall be compacted using a mechanical vibrator or an approved roller.

E. Bond Coat

Bond coat shall be applied to existing pavement surfaces, only when they are clean and dry. Bond coats shall be uniformly applied to the pavement surface with a pressure applicator. Bond coat shall be placed in advance of HMA placement to provide for its curing prior to HMA placement.

Bond coat shall not be allowed to pool on the surface; pooling shall be removed. The adjacent pavement surfaces which are not to be overlaid shall not be sprayed with bond coat.

Bond coat shall be applied to each layer of the HMA pavement and to the vertical edges of the adjacent pavements before placing subsequent courses.

F. Transportation of HMA

HMA shall be transported to the project site in accordance with the requirements of Section 501.03.E of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

Each load of HMA delivered to the project site shall be weighed on an approved scale with automatic print out system. Weights shall be measured to the nearest 20 pounds. Scales and print out systems shall meet the requirements of Section 109 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

G. Placement of HMA

HMA shall be placed in accordance with the requirements of Section 501.03.F of the Michigan Department of Transportation 2020 Standard Specifications for Construction and at the rate shown in the HMA Application Rate table in the project plans.

H. Rolling

HMA shall be rolled in accordance with the requirements of Section 501.03.G of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

I. Smoothness requirements as per the requirements of Section 501.03.H of the Michigan Department of Transportation 2020 Standard Specifications for Construction shall be adhered to.

J. Weather and Seasonal Limitations

1. The Contractor shall not place bond coat or HMA when precipitation is imminent or when there is moisture on the existing surface to be overlaid.
2. HMA shall not be placed when the underlying base is frozen, and the surface being paved is at least 35 degrees Fahrenheit.
3. Unless otherwise approved by the Owner in writing, HMA shall not be placed before May 15 or after November 15.

K. Protection

The Contractor shall protect surfaces, structures, signs, poles, vehicles, and other items adjacent to the area to be paved from being discolored or damaged. Damaged items shall be corrected at the Contractor's expense. The Contractor shall protect the newly placed HMA surface from damage by traffic and construction activities.

\*\*\*END OF SECTION\*\*\*

SECTION 32 13 00  
CONCRETE CURB AND GUTTER, SIDEWALK,  
AND MISCELLANEOUS PAVEMENT

PART 1 - GENERAL

1.01 Work Included

This work includes all preparation, forming, concrete production and placement, finishing, jointing, reinforcing, curing, protection, and restoration for the construction of concrete curb and gutter, sidewalk, and miscellaneous pavement.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- B. ASTM C94 – Standard Specification for Ready-Mixed Concrete
- C. ASTM C150 – Standard Specification for Portland Cement
- D. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- E. ASTM A706, ASTM A615, or ASTM A996 (Type R or Type A only) for Grade 60 steel bars
- F. ASTM A775 for epoxy coated steel reinforcement
- G. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- H. Michigan Department of Transportation 2020 Standard Specifications for Construction
- I. Michigan Department of Transportation Standard Plan

1.03 Related Work

- A. Section 01 45 16.01 – Concrete Testing
- B. Section 01 45 16.02 – Density and Aggregate Testing
- C. Section 02 41 13.13 – Pavement Removal

PART 2 - PRODUCTS

2.01 Materials

- A. Portland cement shall meet the requirements of ASTM C150.

- B. Coarse aggregate shall meet the requirements of Class 6A aggregate, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.
- C. Reinforcing steel fabric shall meet the requirements of ASTM A1064.
- D. Deformed bars must meet the requirements of ASTM A706, ASTM A615, or ASTM A996 (Type R or Type A only) for Grade 60 steel bars, unless otherwise required. All deformed bars shall be epoxy coated.
- E. Epoxy coated steel reinforcement must be coated in accordance with ASTM A775.
- F. White membrane curing compound shall conform to ASTM C309, Type 2. Curing compound shall be agitated to provide a uniform consistency prior to transfer between containers or before application.
- G. Fiber joint filler shall meet the requirements of ASTM D1751.
- H. Sand for base shall meet the requirements of Granular Material Class II, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.
- I. The detectable warning surface shall contrast visually with adjacent walking surfaces. The Contractor shall submit the detectable warning product information to the Owner for approval.
- J. Geotextile liner shall meet the requirements per the Michigan Department of Transportation 2020 Standard Specifications for Construction, as shown in Table 910-1 for physical requirements of geotextile.

## 2.02 Mixtures

Concrete shall be transit mixed 4,000 psi concrete in accordance with ASTM C94 and Section 01 45 16.01 – Concrete Testing.

Air content, slump, and compressive strength shall be according to Section 01 45 16.01 – Concrete Testing. Concrete shall contain at least six sacks of cement per cubic yard of concrete. Modifications and the use of admixtures may be submitted and shall be approved by the Owner.

## 2.03 Submittals

- A. Prior to beginning construction, the Contractor shall submit the name and plant location of the proposed concrete supplier for the project.
- B. Prior to beginning construction, the Contractor shall submit mix designs for the proposed concrete mixtures proposed for use on the project for the Owner to review.

## 2.04 Cross Sections

### A. Sidewalk

Unless indicated otherwise on the plans, sidewalk shall have a minimum thickness of 4 inches. Sidewalk through residential driveways shall have a minimum thickness of 6 inches. Sidewalk adjacent to driving surface shall have a minimum thickness of 6 inches. Sidewalk through

commercial driveways shall have a minimum thickness of 8 inches. Sidewalk through driveways shall be reinforced with #10 by 6 inches by 6 inches welded wire fabric.

B. Pavement

Concrete pavement section shall be as indicated on the plans.

C. Concrete Curbs and Concrete Curb and Gutter

Unless shown otherwise on the plans, concrete curb and concrete curb and gutters shall be in accordance with Michigan Department of Transportation Standard Road Plan R-30 Series.

### PART 3 - EXECUTION

#### 3.01 Coordination of Traffic

Hazardous areas shall be barricaded to protect pedestrian and vehicular traffic.

Work shall be scheduled so that access is maintained to driveways and entrances through the project area to the extent possible. Where a driveway or entrance must be closed for a period, the property owner or occupant shall be notified in advance of the closing.

#### 3.02 Removal of Existing Sidewalk, Curb and Gutter, and Pavement

Where an existing sidewalk, curb and gutter, and/or pavement are to be removed and replaced, the existing structure shall be removed in accordance with Section 02 41 13.13 – Pavement Removal.

#### 3.03 Preparation

The base shall be excavated, filled, and shaped, as required, to construct pavement of the required thickness at the proposed grades and alignment. The base shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Soft and yielding soils shall be excavated and replaced with suitable soils.

Where existing curb and gutter has been removed and prior to constructing new curb and gutter, the Contractor shall install 2 dowels, 1/2-inch in diameter, into existing curb and gutter at each end. Cost of dowels are included in the payment for curb and gutter.

Concrete may be placed by slipforming, unless indicated otherwise.

Where forms are used, the forms shall extend the full depth of the concrete. Forms shall be of sufficient strength and staked to prevent springing or yielding after placement of concrete. Flexible forms capable of making a smooth arc shall be used for curved sections. Face forms for the exposed face of curb are not required.

#### 3.04 Required Grades

A. Driveways shall be constructed with a maximum slope of 10 percent.

B. Sidewalks shall be constructed with a maximum transverse slope of 2 percent. Transverse

slopes shall be at least 1 percent, unless longitudinal drainage is provided. The longitudinal slope of sidewalk shall not exceed the general grade established for the adjacent street or highway. Where adjacent street or highway general grades are less than 5 percent, the longitudinal slope of sidewalk may exceed the general road grade to a maximum of 5 percent.

- C. Gutter grades shall not be constructed flatter than 0.4 percent, or less than the grades shown on the plans, whichever is less.

### 3.05 ADA Requirements

- A. Sidewalks and sidewalk ramps shall meet ADA requirements and shall follow the Michigan Department of Transportation Standard Road Plan R-28-series.

### 3.06 Driveway Openings

Concrete driveway openings shall be constructed in accordance with the Michigan Department of Transportation Standard Road Plan R-29 Series.

### 3.07 Placement of Concrete

Concrete shall not be placed until the forms (or grade, if the concrete will be slipformed) have been inspected by the Owner. The Contractor shall notify the Owner a minimum of 24 hours prior to scheduling a concrete pour.

The base shall be moistened just prior to placement of the concrete.

Concrete shall have a temperature between 45 degrees Fahrenheit and 90 degrees Fahrenheit at the time of placement.

Concrete shall be deposited to the proper depth and spaded or vibrated to ensure proper consolidation. Concrete shall be placed and finished in a continuous operation.

Any material required to fill low spots shall be obtained from the mixture used in the work. Exposed surfaces of the concrete slab shall be finished smooth and even by means of a moistened wood float. Sidewalk and pavement slabs shall be lightly brushed perpendicular to the normal direction of traffic. Water shall not be added to the concrete surface as an aid to finishing. The top edges of the slab and all transverse joints shall be rounded with a finishing tool having a radius of ¼-inch. Surfaces shall not vary more than 3/8-inch from the alignment and typical cross section.

Joints shall be constructed in accordance with the Michigan Department of Transportation Standard Road Plan R-29 and R-30 Series.

Expansion joint filler shall extend the full depth of the concrete, with the top of the filler material just below the finished concrete surface.

Exposed concrete surfaces shall be cured using white membrane curing compound, applied uniformly at a rate of 200 square feet per gallon. Curing compound shall be applied regardless of temperature or humidity conditions.



### 3.08 Protection

Concrete shall not be placed if the air temperature is not at least 25 degrees Fahrenheit and rising, or more than 90 degrees Fahrenheit. Concrete shall be protected from damage caused by freezing or rain.

The Contractor shall provide protection for existing surfaces (building faces, light poles etc.) from splattering of concrete. Any damage to building faces, light poles, etc. from concrete splatter shall be repaired or replaced at the Contractor's expense.

The Contractor shall provide sufficient barricading and security to protect fresh concrete from accidental damage or vandalism. Damaged concrete shall be removed to a joint and replaced at the Contractor's expense.

### 3.09 Cleanup

After the concrete has attained sufficient strength, the forms shall be removed.

Where adjacent areas are turf, the area next to the pavement shall be backfilled with sound earth and topsoil, and graded so the surface is about 1-inch below the pavement or as necessary to provide proper drainage.

\*\*\*END OF SECTION\*\*\*

SECTION 32 17 23  
PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 Work Included

This work includes furnishing and applying pavement markings at locations shown on the plans, in the proposal, or as directed by the Owner, in accordance with the Michigan Manual on Uniform Traffic Control Devices and as specified herein.

The Contractor is responsible for all layout work necessary for the location and placement of pavement markings, as shown on the plans or in the proposal or as directed by the Owner.

All markings, shapes, and dimensions shall conform to the Michigan Department of Transportation Pavement Marking Standards or other details provided.

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Manual on Uniform Traffic Control Devices
- C. Michigan Department of Transportation's Qualified Products List

1.03 Submittals

The Contractor shall submit a list of all proposed materials and suppliers for pavement marking materials for review prior to performing the work.

1.04 Quality Assurance and Quality Control

The Contractor shall maintain and provide the Owner with records of application of pavement marking materials, including paint and beads. The records shall include descriptions of the materials used (manufacturer, batch, date of manufacture, etc.) and quantities of each (gallons of paint or binder, pounds of beads).

PART 2 - PRODUCTS

2.01 Materials

A. General Requirements

All pavement markings must be lead-free and selected from the Michigan Department of Transportation's Qualified Products List. Pavement marking materials must be manufactured in the calendar year in which they are to be applied.

B. Packaging and Labeling

Materials shall be furnished in containers or packages plainly marked showing the manufacturer, description of materials, product identification number, batch number, date of manufacture, contents weight, and contents volume.

## PART 3 - EXECUTION

### 3.01 Applying Pavement Markings

Prior to the application of pavement markings, the pavement surfaces shall be clean, dry, and free of foreign materials. The Contractor shall be responsible for removal of foreign material, which can be removed by air-blasting. The Contractor shall also be responsible for removing occasional debris or dead animals from the line track. When shown on the plans or in the proposal, or when directed by the Owner, curing compound on new concrete shall be removed by light sandblasting.

All materials and glass beads shall be placed according to the manufacturer's requirement.

Pavement markings shall be applied uniformly to the surface and so that they adhere adequately, following manufacturer's recommendations. All materials shall be thoroughly mixed at all times during application. Thinning of liquid materials will not be permitted.

Pavement markings shall be of the width called for on the plans, details, or pay item(s). The markings shall be of the color(s) and configuration as shown on the plans, in the proposal, or as directed by the Owner. A solid line of the color and width specified shall have no gaps or spaces of unapplied material.

Improperly located markings shall be removed at the Contractor's expense, in accordance with Section 811 of the Michigan Department of Transportation 2020 Standard Specifications for Construction and shall be reapplied in the correct locations at no cost to the Owner.

Applied markings shall be sharp and well-defined. The markings shall be free of uneven edges, overspray, or other readily visible defects which, in the opinion of the Owner, detract from the appearance or function of the pavement markings. Appropriate care shall be taken to prevent motorists and adjacent properties from being sprayed. Shields or other devices may be used for this purpose.

Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions, as specified in the pavement marking plans and/or directed by the Owner. The lateral deviation of the finished lines shall not exceed ½-inch from the proposed location alignment, as specified in the plans and/or directed by the Owner.

Any deviation of the pavement marking lines greater than that specified herein, or shown on the pavement marking plans, shall be sufficient cause for requiring the Contractor to remove and correct such pavement markings at no additional expense to the Owner.

Pavement markings shall be protected from damage by the Contractor during the cure period. Pavement markings damaged by traffic, that were not applied and/or suitably protected, shall be traced at the Contractor's expense as directed by the Owner. Tracked lines shall be removed at the Contractor's expense when ordered by the Owner.

Application, temperature, protection, and seasonal restrictions shall be in accordance with Section 811 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

\*\*\*END OF SECTION\*\*\*

## SECTION 321813 - SYNTHETIC GRASS SURFACING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Synthetic grass surfacing.

B. Related Requirements:

1. Section 312000 "Earth Moving" for preparation, compaction, and grading of granular base.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Synthetic grass surfacing.

B. Shop Drawings: For synthetic grass surfacing.

1. Include sections and details.
2. Show locations of seams and method of seaming.
3. Show layout of game lines, numbers, and letters. Indicate application method of each line and marking.
4. Show location and layout of team logo/graphics.

C. Samples: For each type of synthetic grass surfacing indicated.

1. Turf Fabric: 12 inches square.

#### 1.4 INFORMATIONAL SUBMITTALS

Retain "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

A. Qualification Data: For Installer.

B. Product Test Reports: For each synthetic grass surfacing assembly.

- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Turf Fabric: Minimum of 300 sq. ft. for each type indicated.
  - 2. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
  - 3. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration and excessive wear.
    - b. Deterioration from UV light.
    - c. Seam separation, including game lines and markings.
  - 2. Warranty Period: 8 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Synthetic Turf Playing Surfaces: Assembly tested in accordance with ASTM F1551.

### 2.2 SYNTHETIC GRASS SURFACING

- A. Synthetic Grass Surfacing for Field Sports: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing and infill indicated, suitable for multipurpose sport playing fields.
  - 1. Basis of Design: FieldTurf A Tarkett Sports Company, CORE Turf system
    - a. Substitutions: Refer to section 012500
- B. Seaming Method: SecureLock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF SYNTHETIC GRASS SURFACING

- A. Roll out turf fabric and allow to relax at least four hours prior to seaming.
- B. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.
- C. Install inlaid game lines and markings by cutting through turf fabric and installing snugly fitting game line turf fabric. Provide seaming tape that extends minimum 6 inches beyond seam.
- D. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.
- E. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer, and to meet indicated performance requirements. Rake fibers trapped by infill to surface.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION 321813



SECTION 32 31 13  
PVC COATED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 Work Included

This work shall include the excavation for and installation of concrete post bases, and the installation of fence framework, fabric, and accessories.

1.02 Qualifications

A. Manufacturer

Company specializing in the manufacturing of products specified in this section with a minimum of ten (10) years' experience.

B. Installer

Company specializing in performing work of this section with a minimum of five (5) years' experience of comparable projects.

1.03 Project Conditions

A. Field Measurements

Verify layout information for chain link fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.04 Inspection

A. All material installed under this specification shall be subject to testing by Owner. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.

1.05 Submittals

A. Submit shop drawings showing typical fabric pattern, fence and gate construction.

PART 2 - PRODUCTS

2.01 Fence Materials

A. Acceptable manufacturers and products:

1. Merchants Metals – Colorbond I
2. Ameristar – PermaCoat PC-40
3. Design Professional approved equivalent

B. Framework

Conform to Federal Specification RR-F-191 Class 1 Grades A and B. All framework shall be hot dipped zinc galvanized steel pipe.

Four-Foot-High Site Fencing shall be the following size and weight: Gate posts - 3" O.D. SS 40, Corner or terminal posts – 3" O.D. SS 40, Line posts – 2" O.D. SS 20, Top Rail – 1 5/8" O.D. SS 40.

Framework shall be powder coated to match fabric. Any scratched surface shall be touched up with black paint.

C. Vinyl Coated Fabric

Federal Specification SRR-F-191, Type 1, Hot Dipped Galvanized steel wire and 2-inch mesh size. Vinyl coating shall conform to ASTM F668 Class 2B Minimum thickness shall be 0.022 inches. Coating color shall be black. Final finished gauge shall be 8-gauge.

2.02 Accessories

A. Chain link Fence Accessories:

All fence accessories and fittings shall be galvanized, pressed steel and coated with matching PVC by same process as post and rails. Minimum thickness of PVC coating shall be 0.006 to 0.015 mils.

B. Post Caps

PVC-coated formed steel, cast malleable iron, or aluminum alloy weather tight closure cap for tubular posts. Provide one cap for each post. Cap to have provision for barbed wire when necessary. "C" shaped line post without top rail or barbed wire supporting arms do not require post caps. Where top rail is used, provide tops to permit passage of top rail.

C. Top/Bottom Rail and Brace Rail Ends

PVC-coated pressed steel per ASTM F626, for connection of rail and brace to terminal posts.

D. Sleeves

Lengths of top rails to be connected using 6-inch PVC-coated sleeves that allow for expansion or contraction of the rail.

E. Tie Wire

PVC-coated 9-gauge galvanized steel or 6-gauge aluminum for attachment of chain link fabric to posts and rails. Hog rings attach fabric to tension wire to be 12 1/2 GA (0.0985-inch).

F. Brace and Tension (stretcher bar) Bands

PVC-coated pressed steel.

G. Tension (stretcher) Bars (made of one continuous piece of steel or aluminum, 3/16-inch x 3/4-inch). Provide one bar per end or gate post and two bars per corner or pull post.

H. Tension Wire

PVC applied to metallic coated steel wire per ASTM F 1664 Class 2a, 6-gauge, (0.1920-inch) diameter core wire with tensile strength of 75,000 psi.

- I. Truss Rods and Tightener  
PVC-coated steel rods with minimum diameter of 5/16-inch capable of withstanding a tension of minimum 2,000 pounds.
- J. Nuts and bolts are galvanized but not vinyl coated. Touch up nuts and bolts with PVC touch up paint to match fencing.

#### 2.03 Swing Gates

- A. Gate frames shall be constructed of same material used for fencing. Gate framework shall be 2-inch O.D. and shall include a horizontal center brace pipe.
- B. Provide hinges capable of supporting gate and swinging 180 degrees in or out.
- C. Latch shall be Fulcrum type with pad lock hasp.
- D. Provide drop bar to hold one leaf stationary.
- E. Provide hold opens on all gates.

#### 2.04 Warranty

- A. Fencing shall be warranted for a minimum of 15 years against failure due to rust or corrosion.

#### 2.05 Concrete Mix

- A. Concrete Mix shall have a minimum compressive strength of 3,500 psi and shall conform to the requirements of grade S2 concrete as outlined in the Michigan Department of Transportation 2012 Standard Specifications for Construction.

### PART 3 - EXECUTION

#### 3.01 Chain Link Fence Framing Installation

- A. Removal of the existing fence shall include excavation of existing concrete post footings and disposal of all materials off site.
- B. Install framework, fabric, and accessories in accordance with ASTM F567, to result in flat, taut, non-sagging installation.
- C. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- D. Space line posts uniformly at 10-foot on center maximum or per plan.
- E. Set terminal, corner, gate, and line posts per details on plan.
- F. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
- G. Bracing: Install horizontal pipe brace at mid-height for fences 6-foot and over, on each side of

- terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- H. Top/Bottom Rail: Install lengths, 21-foot or 24-foot. Connect joints with sleeves for rigid connections for expansion/contraction.
  - I. Bottom rails are to be installed where shown on drawings.
- 3.02 Gates
- A. Install gates level, plum and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.
- 3.03 Accessories
- A. Tie Wires  
Bend ends of wire to minimize hazard to persons and clothing.
  - B. Fasteners  
Install nuts on side of fence opposite fabric side for added security.
- 3.04 Cleanup and Repair
- A. Repair or replace any damaged finish on the fencing.
  - B. Clean up and dispose of any unused materials.

\*\*\*END OF SECTION\*\*\*

SECTION 32 92 00  
TURF ESTABLISHMENT

PART 1 - GENERAL

1.01 Work Included

This work includes soil preparation, seeding, fertilizing, and mulching on those areas designated for turf establishment.

1.02 References

A. Michigan Department of Transportation Qualified Products List

1.03 Related Work

A. Section 31 25 00 – Soil Erosion and Sedimentation Control

1.04 Performance Requirements for Guaranteed Growth and Smooth Ground Surface

The Contractor is responsible to provide turf, substantially free of bare spots and free of weeds. The ground in turf areas shall be smooth, graded to provide positive drainage, and graded to provide a smooth transition to adjacent areas. The Owner will determine when the requirements of guaranteed growth and smooth ground surface have been met.

Materials, requirements, and methods described in this specification are provided to establish minimum levels. Where the Contractor believes that other materials or methods are appropriate for the specific site conditions or better suited to the Contractor's schedule, the Contractor shall submit details of the alternative materials and/or methods to the Owner for approval.

The Contractor shall provide re-seeding, watering, and herbicides, as necessary, to achieve the desired results.

There will be no adjustment in project cost for re-seeding, watering, application of herbicides, or using alternative methods of turf establishment.

1.05 Areas Designated for Turf Establishment

All areas disturbed by the Contractor's activities or as a result of the project, which are not to be restored with a pavement or aggregate surface, are to be restored with turf, unless specifically directed otherwise.

Turf shall be established on borrow areas and areas where excess soil is stockpiled.

When shown on the drawings or directed by the Owner, the Contractor shall establish turf in other areas.

## PART 2 - PRODUCTS

### 2.01 Materials

#### A. Topsoil

Topsoil shall be a humus-bearing, natural mineral soil of loam, sandy loam, silty loam, or clay loam classification. Topsoil shall neither be excessively acidic or alkaline.

Topsoil shall be screened and free of stones, roots, debris, and other foreign matter. Topsoil which is stripped from the project area shall be removed, transported, and stockpiled in a manner which prevents it from becoming mixed with sub-soils.

#### B. Fertilizer

Fertilizers shall be standard, commercial packaged or bulk products in granular or liquid form. Each container of packaged fertilizer shall be marked by the manufacturer with the following information: manufacturer name; lot number; date; analysis of contents, including the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash; and the net weight. Bulk fertilizer shall be accompanied with an invoice indicating the manufacturer name; lot number; date; analysis of contents, including the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash; and the net weight or volume.

Fertilizer for seeding and sodding shall be comprised of both a water insoluble component and a water soluble component. The water insoluble nitrogen must be from ureaformaldehydes and/or coarse grade isobutylidene diurea.

Fertilizer shall provide 33 pounds of actual water insoluble nitrogen per acre. The water soluble component of the fertilizer shall provide 65 pounds of actual nitrogen, phosphorus, and potassium nutrient per acre, in equal proportions. The water soluble component of the fertilizer shall include urea, diammonium phosphate, and potassium chloride.

#### C. Mulch

##### 1. Loose Mulch

Mulch shall be straw or marsh hay, in an air-dried condition. Mulch material must be clean, undamaged, and rot-free. It must be substantially free of weed seed and other objectionable foreign matter.

##### 2. Turf Mulch Blankets

Mulch blankets shall be manufactured by a company currently listed on the Michigan Department of Transportation's Qualified Products List.

Mulch blankets shall have a net covering on both sides of the blanket and shall be manufactured from either excelsior or straw. Excelsior blankets shall be manufactured from a uniform layer of interlocking excelsior fibers cut from sound, green timber, with an average dry weight of 12 ounces per square yard. Straw blankets shall be made of a uniform layer of clean wheat straw, free of weeds and weed seed, with the straw and net covering securely stitched together to form a uniform mat having an average dry weight of 8 ounces per square yard.

### 3. Mulch Anchoring

Mulching anchoring shall be manufactured by a company currently listed on the Michigan Department of Transportation's Qualified Products List.

Latex-based anchoring shall have a composition, by weight, of 48 percent styrene, 50 percent butadiene, and 2 percent additive, 42 percent to 46 percent solids, and a pH of 8.5 to 10.

Recycled newsprint mulch shall be comprised of specifically prepared, biodegradable, shredded newspaper particles consisting of recycled newsprint fibers. The recycled newsprint must contain a wetting agent, defoaming agent, and nontoxic dyestuff that will impart a bright green or blue color. The dyestuff must adhere tightly to the fiber. Recycled newsprint shall meet the following minimum requirements:

|   |                         |
|---|-------------------------|
| Moisture content (total weight)                       | 12 percent maximum      |
| Shredded high-grade newsprint (oven dry)              | 96 percent minimum      |
| Tackifier, by weight                                  | 1½ percent to 3 percent |
| Water holding capacity (water per 3½ ounces of fiber) | 32 ounces minimum       |

Wood fiber shall be specially prepared, biodegradable, air-dried virgin wood fibers manufactured from 100 percent whole wood chips. The wood fiber must be manufactured with a tackifier. Recycled materials are not acceptable. The fibers must be dyed with a green or blue biodegradable dye to aid in visual metering during construction. The process and materials must not contain growth or germination inhibiting materials. The wood fiber must conform to the following specifications:

|   |                        |
|---|------------------------|
| Moisture content (total weight)                       | 12 percent maximum     |
| Organic wood fiber (oven dry)                         | 95 percent minimum     |
| Tackifier, by weight                                  | 3 percent to 5 percent |
| Water holding capacity (water per 3½ ounces of fiber) | 35 ounces minimum      |

Guar gum tackifiers shall contain a minimum of 95 percent guar gum by weight. The remaining components shall be dispersing and crosslinking additives.

Other tackifiers may include water soluble natural vegetable gums, or guar gums blended with gelling and hardening agents, or a water soluble blend of hydrophilic polymers, viscosifiers, sticking aids, and other gums.

### 4. Mulch Netting

Netting shall have a mesh size not larger than 1½ inches by 2 inches and not smaller than ½-inch by ½-inch. The netting shall be fabricated from a plastic formulated from or treated with a chemical which will promote the breakdown of the net within the first growing season after its placement. The net shall have sufficient strength to hold the mulch in place and still deteriorate rapidly upon exposure to sunlight. Steel staples or pins shall not be used for anchoring of netting.

D. Sod

Sod shall be a densely rooted blend of at least 2 bluegrass varieties with 15 percent to 30 percent creeping red fescue content, reasonably free from weeds and grown on soil that is the same or similar to the topsoil at the project site. Sod shall be selected which will adapt well to the topsoil and ambient conditions at the project site and considering future maintenance.

Before sod is cut, the grass shall be mowed to a maximum height of 4 inches above the ground. The sod must be cut at least ¾-inch thick to retain the dense root system of the grass and to allow handling without undue tearing or breaking. When sod is cut in strips, it must be cut in small, uniform units approximately 1½ feet by 6 feet, or in such widths and lengths that can be handled without tearing or breaking. Sod may be cut, transported, and laid in large rolls.

E. Weed Control

Herbicides must be approved for use by the Michigan Department of Agriculture and the U.S. Environmental Protection Agency.

2.02 Seeding Mixtures

Seed shall be furnished in durable bags, each with a tag indicating the seed supplier, lot number, date, mixture proportions, purity, germination, and net weight.

Seed mixtures shall meet the requirements of one or more of the following mixtures, or other mixtures that are approved in advance by the Owner. Where the Contractor believes that another mixture is appropriate for areas within the limit of the project, the Contractor shall request that the Owner review and approve the substituted mixture(s). Requests for substitutions shall include the name of the seed supplier, the mixture proportions, the purity, and the germination.

| Species             | Purity,<br>Minimum<br>(percent) | Germination<br>(percent) | Seed Mixture                            |     |     |     |     |     |     |
|---------------------|---------------------------------|--------------------------|---|-----|-----|-----|-----|-----|-----|
|                     |                                 |                          | Mixture Proportions (percent by weight) |     |     |     |     |     |     |
|                     |                                 |                          | TDS                                     | THV | TUF | TGM | THM | CR  | TSM |
| Kentucky Blue Grass | 98                              | 85                       | 5                                       | 15  | 10  | 10  | 30  |     |     |
| Perennial Ryegrass  | 96                              | 85                       | 25                                      | 30  | 20  | 20  | 20  |     | 50  |
| Hard Fescue         | 97                              | 85                       | 25                                      |     | 20  | 30  |     |     |     |
| Creeping Red Fescue | 97                              | 85                       | 45                                      | 45  | 40  | 40  | 50  |     |     |
| Fults Salt Grass    | 98                              | 85                       |   | 10  | 10  |     |     |     |     |
| Cereal Rye          | 85                              | 85                       |   |     |     |     |     | 100 |     |
| Spring Oats         | 85                              | 85                       |   |     |     |     |     |     | 50  |

PART 3 - EXECUTION

3.01 Preparation for Turf Establishment

A. Topsoil Stripping

Prior to performing any excavation, filling, grading, or other earthwork, the Contractor shall



strip and stockpile topsoil for later use on the project. Excess topsoil shall not be removed from the project site unless specifically provided elsewhere in the contract documents.

**B. Finish Grading**

The areas that are to be seeded shall be properly graded, sloped, and shaped with an allowance for the thickness of the topsoil layer. The earth bed upon which topsoil will be placed shall be friable to a depth of at least 4 inches. Earth beds not in a friable condition shall be harrowed with a disk, spring tooth drag, or similar equipment.

**C. Placement and Preparation of Topsoil**

Topsoil shall be spread on the prepared areas to a depth of 4 inches (in place, after rolling or compaction), unless otherwise shown on the plans or proposal. After spreading, any large clods or lumps shall be broken and all stones larger than 1-inch diameter, rocks, roots, litter, and other foreign debris shall be raked up and disposed of by the Contractor. After spreading and raking, the topsoil surface shall be in a friable condition and the surface shall be reasonably close to the proposed grades and cross section.

The topsoil surface shall be shaped to provide proper drainage. Where proposed grades are not shown on the plans, the topsoil surface shall be graded to provide a smooth transition between the new construction and the existing, adjacent ground.

Excess topsoil shall be stockpiled in a location acceptable to the Owner and neatly trimmed to present a neat appearance.

**3.02 Turf Establishment**

**A. Permanent Seeding and Fertilizing**

Disturbed areas shall be seeded upon completion of earthwork and grading operations. Disturbed areas shall be stabilized with temporary seeding if permanent seeding cannot be completed.

Seed mixtures for permanent seeding shall be appropriate for the soil type and location, as indicated in the following table. The Contractor may propose and submit alternative mixtures to the Owner for review and approval. It is the Contractor's responsibility to provide turf areas which are substantially free of bare spots and generally weed-free.

| <b>Mixture Designation</b> | <b>Soil Type</b>       | <b>Location</b>          |
|----------------------------|------------------------|--------------------------|
| TDS                        | Dry Sandy to Sand Loam | Rural or Urban           |
| THV                        | Heavy                  | Rural                    |
| TUF                        | All Types              | City Streets             |
| TGM                        | Medium to Heavy        | All                      |
| THM                        | Loamy to Heavy         | Residential / Commercial |

Fertilizer and seed shall be applied uniformly on areas prepared for seeding. Seed shall be applied at a rate of 220 pounds per acre. Seed and fertilizer may be applied by drilling, broadcasting, or hydraulically. Seed and fertilizer shall be applied before applying mulch. Seed and fertilizer shall be lightly raked or rolled into the prepared topsoil surface.

Neither broadcast seeding nor hydraulic seeding shall be performed during windy weather.

There shall be provisions for mixing or agitating the seed – fertilizer mixture used for hydraulic seeding to keep it evenly distributed in suspension. Mixtures shall be applied within an hour of mixing the seed with water; unused portions shall be discarded.

**B. Sodding**

Areas to be sodded shall be prepared by grading the area to the desired elevations and contours, less the depth of the topsoil surface and thickness of the sod. Four inches of screened topsoil shall be provided. The topsoil shall be conditioned by harrowing prior to laying the sod. In sloped areas, the harrowing shall be perpendicular to the slope.

The earth bed shall be thoroughly watered just before laying the sod. Sod shall be laid within 24 hours after cutting and shall be properly protected until it is placed. Sod that has been allowed to dry out will not be accepted. Sod shall not be placed on frozen soil, nor shall sod be frozen.

Sod strips shall be placed parallel with the flow of water on slopes and in ditches. The short ends of strips shall be staggered. Strips shall be placed with tight joints. Sod shall be laid starting at the base of the slope and progress upward. The edges of sodded areas shall transition by turning the edges of the sod into the ground and covering the edge with earth (or aggregate if adjacent to a road or pavement) and compacting the covering so that runoff is directed onto the sod. Sod placed adjacent to paved surfaces shall be firmly butted against and level with them.

Sod shall be firmly compacted by tamping it immediately after its placement to provide a surface even, smooth, and free of bumps and depressions. The Contractor shall thoroughly water sod following its placement, and periodically until it has become established.

**C. Temporary Seeding**

Temporary seeding shall be completed when the permanent seeding cannot be completed because of seasonal conditions. Temporary seeding shall be applied at a rate of 100 pounds per acre, and shall be of the following designation.

| <b>Mixture Designation</b> | <b>Soil Type</b> | <b>Location</b>               |
|----------------------------|------------------|-------------------------------|
| CR                         | All Types        | Temporary, less than 6 months |
| TSM                        | All Types        | Temporary, more than 6 months |

Before completion of the contract, the Contractor shall complete permanent seeding of all areas which are temporary seeded.

**D. Dormant Seeding**

Dormant seeding should be used only when necessary to complete a project when seasonal conditions are not conducive to permanent seeding. Dormant seeding shall not be completed on frozen ground. Dormant seeding shall be completed, as required, for permanent seeding.

The Contractor is responsible to establish turf which is substantially free of bare spots and generally free of weeds.

### 3.03 Mulching

#### A. Mulch Placement

Immediately after the seed has been set into the topsoil surface by light raking or rolling, the Contractor shall spread mulch and anchor it as appropriate. Mulching shall not be performed during windy conditions.

Loose mulch shall be placed thick enough to shade the ground, conserve moisture, and resist erosion, but open enough to allow sunlight to penetrate and air to circulate.

The Contractor shall maintain mulched areas and repair any areas where damage from erosion, wind, traffic, fire, or other causes occur.

Mulch shall be applied at a uniform rate of 2 tons per acre, except that a rate of 3 tons per acre is required with dormant seeding.

#### B. Mulch Anchoring

Mulch anchoring (tackifiers) shall be sprayed immediately after the mulch is placed. Spraying shall not be performed when wind might prevent the proper placement of the adhesive. The Contractor shall provide protection measures, as necessary, to protect traffic, signs, structures, and other objects from being marked or disfigured by tackifier materials.

Latex based adhesive shall be mixed at a rate of at least 15 gallons of adhesive with a minimum of 250 pounds of recycled newsprint and 375 gallons of water.

Recycled newsprint shall be mixed at a minimum rate of 750 pounds of newsprint with 1,500 gallons of water.

Wood fiber shall be mixed at a minimum rate of 750 pounds of wood fiber with 1,500 gallons of water.

Guar gum shall be mixed at a minimum rate of 100 pounds of dry adhesive and a minimum of 250 pounds of recycled newsprint and 1,300 gallons of water.

Other tackifiers shall be mixed at a minimum rate of 100 pounds of dry adhesive with a minimum of 250 pounds of recycled newsprint with 1,300 gallons of water.

#### C. Mulching Netting

When netting is used to secure mulch, it shall be secured with anchors, staples, or pins. The net shall be spread over the mulch so that a worker can walk between adjacent widths of the net. The edges of adjacent widths of net shall be pulled together and held in place with net anchors. Net anchors shall be spaced not more than 30 inches apart along the edges, joints, and centerline. The net shall not be installed in direct contact with the ground. If the Contractor elects to use mulch netting or blankets, the Contractor will be required to remove the netting fabric once the turf is established.

#### D. Mulch Blankets

Mulch blankets shall be installed within one day of seeding. The side edges of blankets shall be overlapped by 2 inches. Blanket ends shall be shingle lapped 6 inches. Non-metallic staples or pegs shall be placed along all joint edges and along blanket centerlines at a maximum spacing of 2 feet. Blankets in waterways shall be shingle lapped 12 inches on the downslope edge. If the Contractor elects to use mulch netting or blankets, the Contractor will be required to remove the netting fabric once the turf is established.

High velocity blankets shall be installed on slopes of 1:2, or steeper, on ditch bottoms, on ditch side slopes (to an elevation 1 foot above the ditch bottom), and where specifically shown on the drawings or directed by the Owner.

#### 3.04 Weed Control

Weed control shall be provided by the Contractor, as necessary, to develop turf areas which are relatively free of weeds. Herbicides shall be applied in accordance with federal, state, and local regulations. Herbicides shall be applied in accordance with manufacturer's instructions. Herbicides shall be applied by commercial applicators, licensed in the State of Michigan and certified by the Michigan Department of Agriculture in the appropriate category(ies).

Target weeds shall be sprayed in the newly seeded turf when the new turf grass is sufficiently established to withstand the application of herbicide. Herbicide application shall be repeated if the first application failed to control target weeds.

The Contractor shall take appropriate measures to preserve and protect adjacent property from damages resulting from the application of herbicides. Herbicides shall not be applied when wind may carry it to adjacent areas.

\*\*\*END OF SECTION\*\*\*

SECTION 32 93 00  
LANDSCAPING

PART 1 - GENERAL

1.01 Work Included

This work includes excavating planting areas for trees and shrubs, disposing of excess soils, furnishing and planting trees and shrubs of the size and type shown on the plans, backfilling the planting holes with prepared soil, watering and cultivating, and such other work necessary to complete the landscaping as described herein.

This work includes a guarantee of one complete growing season for all planted materials. Where planted materials fail to become established after one complete season, they shall be replaced by the Contractor.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

A. ANSI Z60.1 – Nursery Stock

PART 2 - PRODUCTS

2.01 Materials

A. Nursery Stock

1. Requirements – General

Nursery stock shall be from nurseries located in Zones 4, 5, or 6 of the USDA Hardiness Zone Map.

All stock shall comply with state and federal laws, with respect to inspection for plant diseases and insect infestation, and the Contractor shall maintain the file with the department with all certificates of such inspection.

Any stock which does not conform to these specifications will be rejected and shall be immediately removed by the Contractor.

All nursery stock shall be true to type and name, in accordance with the current edition of *Standardized Plant Names* published by the American Joint Committee on Horticultural Nomenclature. Stock shall be clearly labeled as to species and variety, giving both the common name and scientific names of the plant. The label or tag shall be securely attached to the plant. When age is specified, the label shall also provide such information. The plant shall be of first-class quality, with well-developed branch systems and vigorous, healthy root systems. All stock shall be well-formed and the trunks of trees shall be uniform and straight. They shall be free from insects, disease, and defects. Thin, weak

plants will not be accepted. All stock shall be nursery grown and shall qualify under ANSI Z60.1, except that the size of ball shall not be less than that shown on the plans.

The stock shall come directly from the nursery row. Cold storage plants will not be accepted unless authorized. Substitution shall not be made except with the written permission of the Owner, and then only when sufficient evidence is shown that the stock called for cannot be secured. Container grown plants shall be used, as called for on the plans or as approved by the Owner. Such plant material shall meet current ANSI Z60.1.

Inspection of nursery stock will be made at the nursery, by the Owner, whenever such inspection is deemed advisable. Approval on such inspection shall not be construed as an acceptance of it. Acceptance for planting will not be made until the stock has been delivered and inspected at the planting project site. Inspection will include examination of the root systems of plants. Plants may be examined by removing soil from the root systems of balled or container-grown plants, or digging in the nursery row. Sufficient plant root systems will be inspected for each species and separate plant source to determine the extent and condition of plant root systems. Payment will not be made for plants rendered unsuitable for planting because of the root system inspection. The Contractor shall give the Owner at least 24 hours' notice before making any delivery of stock, and each shipment shall be accompanied by an invoice showing sizes, species, and varieties included.

Deciduous shade trees shall be straight and symmetrical, with a crown having a persistent main leader. The amount of crown shall be in good overall proportion to the total height of the tree.

Where a clump is specified, it shall have a minimum of two stems originating from a common base at the ground line.

## B. Natural Materials

### 1. Mulching Materials

Shredded Bark: This material shall consist of tree bark which has been stripped and shredded from saw logs by means of a de-barking machine. The material shall be sufficiently fine and free from extraneous material so that it will readily pass through a conventional mulch blower.

### 2. Prepared Soil

Topsoil shall consist of the dark brown or black loam, clay loam, silt loam, or sandy loam surface of a fertile, friable, humus soil, or mineral origin.

Peat moss shall consist of finely-shredded sphagnum or fibrous peat moss of an approved commercial grade, free from woody substance.

The fertilizer for mixing with peat moss and topsoil shall be a ready-mixed granular material containing equal amounts, by weight, of phosphorus and potassium.

Prepared soil shall consist of a uniform mixture of topsoil, peat moss, and fertilizer. The prepared soil shall be proportioned such that a cubic yard of the prepared soil will contain

¾-cubic yard of topsoil, ¼-cubic yard of peat moss, and sufficient chemical fertilizer to provide 1 pound each of available phosphorus and potassium (5 pounds of 0-20-20, 10 pounds of 0-10-10, etc).

Prepared soil shall be produced by thoroughly mixing the component materials prior to final placement.

#### C. Accessories

##### 1. Wrapping and Baling Materials

Twine for use in tree wrapping shall be composed of a minimum of two-ply jute material. Baling material shall be untreated burlap or other material which will readily decompose. Synthetic materials, such as nylon or plastic, will not be permitted for wrapping or baling.

### PART 3 - EXECUTION

#### 3.01 Preparation

Individual holes shall be centered at the proposed plant locations, dug cylindrical in shape with perpendicular sides and flat bottoms. Unless otherwise specified, the minimum diameters and depths of planting holes shall be large enough to permit placing a minimum of 8 inches of prepared soil below, and 12 inches laterally, beyond the ends of bare roots of root balls. Where special conditions of soil or plant requirements so dictate, planting hole sizes shall be subject to reasonable variation.

If site preparation precedes planting by more than two weeks, the planting holes shall be immediately backfilled with prepared soil.

All plant material shall be clearly labeled as to species and variety. At time of planting, the label or tag shall be securely attached to each plant and shall show the scientific name of the plant. Unless otherwise shown on the plans, all plants shall be balled and burlapped or container grown.

Nursery stock shall be prepared for shipment, in accordance with the requirements of the current ANSI Z60.1, and shall be enclosed or covered during transportation to prevent drying.

In preparation for spring planting, all baling operations shall be completed prior to "bud break". All stock shall be dug and packed with care immediately prior to shipment. Plants shall be dug and transported so as to provide and retain a firm ball of earth. The roots shall be carefully protected with wet straw, moss or other material. The root balls shall be adequately protected from rain or sudden changes in the weather. Trees or plants will not be accepted if the balls of earth are loosened or broken.

Plants furnished in containers shall have grown in the container for at least one growing season. Plants other than ground covers, over-established in the container as evidenced by "pot bound" root ends, will not be accepted.

Immediately following delivery and inspection at the job, all plants with exposed roots shall be "heeled in" in moist soil. All "heeled in" plants shall be protected and their roots kept moist until

planted. The "heeling in" grounds shall be a well-protected, shaded area or a well-ventilated enclosure.

The roots of all planting stock shall be kept moist and adequately protected at all times.

The trunks and branches of all trees shall be carefully protected from injury of any kind during all operations. Any trees that are injured may be rejected.

### 3.02 Planting

Just prior to planting, the earth in the bottom of the holes shall be loosened to a depth of 2 inches, and the earth in the sides shall be loosened to the extent necessary to break the glaze caused by digging.

For plants located on slopes, an earth saucer or berm shall be constructed half way around each plant on the down-slope side. The saucer or berm shall have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. Soil shall not spill down-slope more than 18 inches.

Plants shall be set plumb. Their depth, after setting, shall be the same as the depth in their original location. The prepared soil shall be carefully puddled and thoroughly firmed at intervals during backfilling, under and around the ball. Care should be exercised to prevent damaging the root ball during the tamping operation. When the plant hole has been backfilled and compacted to one-half depth, the burlap and lacing shall be removed from the upper half of the ball. The backfilling of the hole with prepared soil should then continue to an elevation which, after compaction, is flush with the ground line.

When plants are furnished in containers, the containers shall be removed at the time of planting. Handling methods, which result in a broken or excessively loosened root and soil ball mass, will be sufficient reason for rejection of the plant.

A maximum of root growth shall be preserved and no root pruning will be permitted. Plants shall be set plumb and at a depth equal to the depth in their original location. The exposed roots shall be held firmly in the proper position with the roots spread out. The prepared soil shall be puddled around the roots and thoroughly firmed at intervals during the process of backfilling. Sufficient water shall be used to ensure thorough saturation of the prepared soil placed in the plant hole.

All new and existing trees shall be provided with a 4-foot diameter spade cut mowing ring. Each mowing ring shall be covered with 1 layer of weed suppressing permeable fabric and then 3 inches of shredded bark mulch.

### 3.03 Pruning, Watering, Cultivating

All pruning shall be done by workmen experienced in this type of work. Pruning shall be completed prior to planting.

The branches shall be pruned to balance the loss of roots in such manner as to retain the natural form of the plant type. Usually one-third to one-half of the branches shall be removed, but the



proportion shall in all cases be subject to the approval of the Owner. The height ratio of crown to trunk, after pruning, shall be approximately one-third crown to two-thirds trunk. The primary leader shall not normally be cut back. Branches to be removed shall be cut off flush with the trunk or main branch.

Immediately upon completion of the planting work, the Contractor shall clean up the area of surplus materials.

The Contractor shall be responsible to water plants, as necessary, throughout the period of establishment. The intervals between waterings shall be determined by the Contractor, based on their experience and climatic conditions.

At the time of final watering, wrapping material, identification tags, and inspection tags shall be removed and disposed of off the project.

#### 3.04 Period of Establishment

A period of establishment, commencing at the completion of the initial planting and extending through the following complete growing seasons, will be required for all plants. A growing season is defined as the months of June, July, and August.

All plants shall be in a thriving growing condition at the start of the establishment period.

The Owner will inspect the plants at the end of the first complete growing season to determine any unacceptable plants. Replacement plants shall be planted, as specified in this specification, prior to May 10 of the following spring planting season. This will fulfill the one-year warrantee on the original plantings and no additional warrantee is required for the replacement plants.

\*\*\*END OF SECTION\*\*\*

SECTION 33 11 00  
WATER MAIN

PART 1 - GENERAL

1.01 Work Included

The Contractor shall install water main and appurtenances in accordance with this specification. This work includes excavation, pipelaying, backfilling, and testing.

The Contractor shall protect existing utilities during construction, whether the existing utilities are shown on the plans or not. Utilities damaged by construction shall be repaired in a manner satisfactory to the Owner and at the Contractor's expense. The Contractor shall call MISS DIG (800-482-7171) for staking and locating the existing utilities.

The water department will assist the Contractor in locating existing water service leads and mains.

The Contractor shall contact the water department to schedule work that may interfere with existing water service.

The Contractor shall develop a construction sequencing plan and submit to the Owner for approval. The construction sequence shall minimize interruption of service.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ANSI A21.4/AWWA C104 – American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- B. ANSI A21.5/AWWA C105 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
- C. ANSI A21.11/AWWA C111 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- D. ANSI A21.50/AWWA C150 – American National Standard for Thickness Design for Ductile-Iron Pipe
- E. ANSI A21.51/AWWA C151 – American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
- F. ANSI A21.53/AWWA C153 – American National Standard for Ductile-Iron Compact Fittings for Water Service
- G. AWWA C110 – Ductile-Iron and Gray-Iron Fittings
- H. AWWA C115 – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
- I. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service

- J. AWWA C504 – Rubber-Seated Butterfly Valves
- K. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
- L. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
- M. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- N. AWWA C651 – Disinfecting Water Mains
- O. AWWA C800 – Underground Service Line Valves & Fittings
- P. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution
- Q. AWWA C904 – Crosslinked Polyethylene (PEX) Pressure Tubing, 1/2 In. (13 mm) Through 3 in. (76 mm) for Water Service
- R. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
- S. AWWA C908 – Standard for PVC Self-Tapping Saddle Tees for Use on PVC Pipe
- T. AWWA C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
- U. ASTM B88 – Standard Specification for Seamless Copper Water Tube
- V. ASTM B251 – Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
- W. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- X. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
- Y. ASTM D2657 – Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- Z. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- AA. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- BB. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- CC. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- DD. ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- EE. ASTM F2080 – Standard Specification for Cold-Expansion Fittings with Metal Compression Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe

- FF. ASTM F2657 – Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
- GG. ISO 9002 – Model for Quality Assurance in Production, Installation and Servicing
- HH. CSA B137.5 - Crosslinked Polyethylene Tubing Systems for Pressure Applications
- II. DIPRA – Polyethylene Encasement Installation Guide
- JJ. DIPRA – Thrust Restraint Design for Ductile Iron Pipe
- KK. NSF/ANSI Standard 14 – Plastics Piping System Components and Related Materials
- LL. NSF/ANSI Standard 61 – Drinking Water System Components-Health Affects
- MM. Plastic Pipe Institute TR-3/2021/HDB/HDS/PDB/SDB/MRS/CRS Policies

#### 1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 01 55 26 – Maintaining Traffic
- C. Section 01 71 23.16 – Construction Staking by Contractor
- D. Section 01 74 50 – Cleanup and Restoration
- E. Section 02 41 13.13 – Pavement Removal
- F. Section 31 10 01 – Clearing and Removal of Miscellaneous Structures
- G. Section 31 23 02 – Excavating and Backfilling for Utility Construction
- H. Section 31 25 00 – Soil Erosion and Sedimentation Control
- I. Section 32 11 23 – Aggregate Base
- J. Section 32 12 16 – HMA Paving
- K. Section 32 13 00 – Concrete Curb and Gutter, Sidewalk, and Miscellaneous Pavement
- L. Section 32 92 00 – Turf Establishment

#### 1.04 Submittals

Submit shop drawings or manufacturer's data to the Owner for review and approval prior to ordering for the following:

- A. Valves
- B. Pipe, including fittings and joints
- C. Restraints
- D. Curb stops, corporation taps, and curb stop boxes
- E. Tracer wire and splice connections

## F. Directional Bore

### 1. Work Plan

Prior to beginning work, the Contractor shall submit to the Owner a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan, and contingency plans for possible problems. The work plan should be comprehensive, realistic, and based on actual working conditions for this particular project. The work plan should document the thoughtful planning required to successfully complete the project.

### 2. Equipment

Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include, but not be limited to: drilling rig, mud system, mud motors (if applicable), downhole tools, guidance system, and rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that the Contractor intends to use or might use shall be submitted.

## 1.05 Quality Assurance and Quality Control

### A. Leakage

The completed pipeline shall be subjected to a hydrostatic pressure test in accordance with Section 3.19.

### B. Bacteriological

Following disinfection, a bacteriological test shall be completed in accordance with Section 3.19.

## 1.06 Local Standards

The Owner's standards for materials are shown on the plans. Where there is a conflict between the Owner's standards and the specifications, the Owner's standards prevail.

## 1.07 Directional Bore Contractor's Qualifications and Experience

All directional boring operations shall be done by a qualified directional boring Contractor, with at least five years of experience involving work of a similar nature to the work required of this project.

Notify the Owner a minimum of three days in advance of the start of work.

All work shall be performed in the presence of the Owner.

## PART 2 - PRODUCTS

### 2.01 Materials

#### A. Pipe

Pipe may be any of the following materials, except where a specific material is indicated on the plans or in the proposal.

##### 1. Ductile Iron Pipe (Thickness Class)

Ductile iron pipe shall meet ANSI A21.51/AWWA C151. Pipe shall be cement lined and shall meet ANSI A21.4/AWWA C104. Pipe wall thickness shall conform to ANSI A21.50/AWWA C150 and shall be of the following thicknesses, unless specifically noted otherwise on the plans or in the proposal:

| <b>Pipe Diameter<br/>(inches)</b> | <b>Pipe Class<br/>(psi)</b> |
|-----------------------------------|-----------------------------|
| 4                                 | 52                          |
| 6                                 | 52                          |
| 8                                 | 52                          |
| 10                                | 52                          |
| 12                                | 52                          |
| 14                                | 54                          |
| 16                                | 54                          |
| 18                                | 54                          |
| 20                                | 54                          |
| 24                                | 54                          |

The pipe manufacturer and class shall be marked on each length of pipe.

Joints for buried pipe shall be either mechanical type or push-on type, in accordance with ANSI A21.11/AWWA C111. Working pressure shall be 350 psi. Provide electrical conductivity at each joint.

Joints for piping in structures shall be flanged.

Joints for directionally bored pipe shall be snap lock gasket style manufactured by Griffen, or as approved by the Owner.

##### 2. Polyvinyl Chloride (PVC) Pipe

PVC pipe shall meet the requirements of AWWA C900. Pipe shall have a ratio of diameter to wall thickness (DR) of 14 (Pressure Class 305), for 6-inch thru 12-inch diameter pipe and DR 18 (Pressure Class 235) for pipe diameters larger than 12-inch, unless noted otherwise on the plans or on the proposal.

Pipe shall meet both NSF/ANSI Standard 61 and NSF/ANSI Standard 14. Pipe shall be marked with "NSF-PW" to indicate its compliance with these standards.

The pipe manufacturer and class shall be marked on each length of pipe.

Joints for pipe shall be push-on type with elastomeric gaskets meeting the requirements of ASTM D3139.

3. Molecularly Oriented Polyvinyl Chloride (PVCO) Pipe

PVCO pipe shall meet the requirements of AWWA C909. Pipe shall be of the class(es) indicated in the following table, unless specifically noted otherwise on the plans or in the proposal:

| Pipe Diameter<br>(inches) | Pressure Class<br>(psi) |
|---------------------------|-------------------------|
| 6                         | 305                     |
| 8                         | 305                     |
| 10                        | 305                     |
| 12                        | 305                     |
| 16                        | 165                     |

Pipe shall meet both NSF/ANSI Standard 61 and NSF/ANSI Standard 14. Pipe shall be marked with "NSF-PW" to indicate its compliance with these standards.

The pipe manufacturer and class shall be marked on each length of pipe.

Joints for pipe shall be push-on type with elastomeric gaskets meeting the requirements of ASTM D3139.

B. Fittings

Fittings shall be mechanical joint or push-on type, either cast iron or ductile iron as follows: Cast iron fittings shall meet the requirements of AWWA C110 and shall be rated for 350 psi working pressure. Ductile iron fitting shall meet the ANSI A21.53/AWWA C153 and shall be Class 350. Fittings shall be cement lined in accordance with ANSI A21.4/AWWA C104. Rubber gasket joints shall meet ANSI A21.11/AWWA C111. Electrical conductivity shall be provided at each joint.

C. Gate Valves

Gate valves shall meet the Owner's standards for manufacturer, style, and opening direction.

Gate valves shall be iron body, non-rising stem, resilient wedge type meeting the requirements of AWWA C509. Gate valves shall be designed for direct bury application.

Resilient seated valves shall meet the requirements of AWWA C509, thick wall valves shall meet AWWA C515.

D. Copper Pipe

Copper pipe shall be constructed of Type K, soft temper copper tubing for underground use, in accordance with ASTM B88 and B251. The manufacturer and pipe type shall be marked on the outside of the pipe. The weight per foot of copper tubing shall meet or exceed that specified by ASTM B251, Table II.

E. Crosslinked Polyethylene (PEX) Water Service Pipe

PEX pressure tubing shall be made from material having a standard PEX material designation code of PEX 1306, or higher, according to ASTM F876 and intended for use as underground potable water, reclaimed water, and wastewater service lines that conform to a standard dimension ratio of SDR 9. Tubing may incorporate an optional polymeric outer layer.

Pipe shall be certified to AWWA C904 by approved testing agency. In addition, pipe shall be certified to standards ASTM F876, CSA B137.5, NSF 14, and NSF 61, by approved testing agencies, with a standard materials designation code of 3306.

Pipe shall demonstrate ability to satisfy the performance requirements of section F.7 of PPI TR-3 for PE materials in order to apply a 0.63 design factor resulting in a temperature/pressure rating of 200 psi at 73.4 degrees Fahrenheit (1380 kPa @ 23°C).

Pipe shall be rated for 160 psi at 73.4 degrees Fahrenheit (1103 kPa @ 23°C) and 100 psi at 180 degrees Fahrenheit (690 kPa @ 82°C) per PPI TR-4.

Pipe shall have a co-extruded UV Shield made from UV-resistant high-density polyethylene. Pipe shall have minimum recommended UV exposure time of one (1) year when tested in accordance with ASTM F2657, or as per manufacturer's recommendations.

Pipe shall be compatible with cold-expansion compression-sleeve fittings certified to ASTM F2080 for installations as cold as -40 degrees Fahrenheit (-40°C).

Pipe shall be approved for use with AWWA C800 fittings when using manufacturer's recommended insert.

Pipe shall be approved by manufacturer for use with manual plastic pipe squeeze-off tools for temporary stoppage of flow.

F. Stops and Fittings

Corporation stops, curb stops, and fittings shall be fabricated of brass and shall be lead free.

For PVC pipe, any taps 2 inches or less shall be Style 202B saddle with stainless steel bands, as manufactured by Ford Brass or approved equal.

G. Service Boxes

Water services boxes shall be of a style conforming to the Owner's standard. Boxes shall be adjustable, a minimum of 6 inches above and below finish grade.

H. Valve Boxes

Valve boxes shall be made of good quality cast iron and shall be of the sectional type. The lower section shall be a minimum of 5 inches in diameter, enlarged at the base to fit around the bonnet of the valve. The upper section shall be arranged to slide or screw down over the adjoining lower section and shall be full diameter throughout. Valve boxes shall be provided with cast iron lids or covers. Lids or covers shall be marked "WATER". The over-all length of valve boxes shall be sufficient to permit the top to be set flush with the final ground surface



grade. Valve boxes shall be as manufactured by Traverse City Iron Works, Clow Corporation, or equal.

I. Tracer Wire

Tracer wire shall be designed and manufactured for the purpose of detecting buried utilities. Tracer wire shall be 12 AWG (minimum) copper wire coated with a 30 mil (minimum) polyethylene jacket. The Contractor shall use larger wire, when necessary, for installation without damage during bored installations.

J. Polyethylene Encasement

Polyethylene encasement shall be in tube and sheet form, fabricated from either linear low-density polyethylene film having a thickness of at least 8 mils or high-density, cross-laminated polyethylene film with a thickness of at least 4 mils.

### PART 3 - EXECUTION

#### 3.01 Alignment and Grade

The water mains shall be constructed at the alignment and grades indicated in the plans and specifications, except where changes are directed or approved by the Owner. Fittings, valves, hydrants, and service connections shall be installed at the locations indicated on the drawings or in the specifications, except where field conditions warrant changes which are directed and approved by the Owner.

Valves and hydrants shall be installed plumb. Valve operating stems shall be installed in a manner to allow for their proper operation.

#### 3.02 Investigation

Prior to excavation, the Contractor shall call MISS DIG and shall contact utility agencies which are not part of the MISS DIG system to make arrangements for identifying the location of existing utilities in the project area. Where potential conflicts are suggested by the plans and/or the utilities' locations, the Contractor shall excavate and expose the existing utilities at least 100 feet in advance of pipelaying operations. Where the existing utilities may conflict with the proposed alignment and construction, the Contractor shall make such appropriate modifications to the alignment and grade, as necessary, to prevent a conflict. Changes to the alignment and grade shall be as directed and approved by the Owner. Changes to the alignment and grade shall be completed by the Contractor at no additional cost to the project.

#### 3.03 Excavation

The Contractor shall excavate all materials to the depths necessary to construct the water main as shown on the plans. Excavation shall include the removal of rock, dirt, abandoned pipelines, old foundations, stumps and roots, and similar materials encountered. Excavation of whatever material encountered shall be included in the contract unit prices for water main installation and will not be paid for separately.

Excavation shall be in accordance with Section 31 23 02 – Excavating and Backfilling for Utility Construction.

### 3.04 Pipe Handling

Pipe shall be handled in such a manner as to prevent the ends from splitting, damages to the protective coatings, and other undesirable conditions. Pipe shall not be dropped, skidded, or rolled into other pipe. Repairs to damaged pipe must be approved by the Owner.

### 3.05 Pipe Cutting

Pipe cutting shall be done in a neat and workmanlike manner, without damage to the pipe or lining, and as to leave a smooth end at right angles to the axis of the pipe. Cutting shall be done by an approved mechanical saw or cutter. Hydraulic squeeze cutters are not acceptable.

### 3.06 Pipelaying

Pipe located inside structures shall be rigidly supported.

Pipe laid underground shall be uniformly supported through its entire length on a 4-inch cushion of sand. A depression shall be carved out of the sand cushion to accommodate the pipe bells.

Pipe shall be inspected for defects, debris, or dirt while suspended in a sling prior to lowering it into the trench. Defective pipe shall be removed from the project site immediately. Lumps, blisters, and excess coal tar coating shall be removed from inside the bell and outside the spigot. These areas shall be wire-brushed and wiped clean with a dry oil-free rag. No debris, tools, clothing, or other materials shall be allowed in the pipe.

Pipe shall be laid in a dry trench, with bell ends facing in the direction of laying. After placing a length of pipe in the trench, and after installing the gasket and applying the gasket lubricant, the spigot end shall be centered in the bell, and the pipe pushed home and brought to the correct line and grade. The pipe shall be secured in place by tamping sand around it. Precautions shall be taken to prevent soil from entering the joint space.

A watertight plug shall be inserted in the open end(s) of the pipe to prevent water, soil, animals, or other foreign matter from entering the pipe during the construction phase.

When it is necessary to deflect pipe from a straight line, either horizontally or vertically, the deflection shall not exceed the following values:

| <b>Nominal<br/>Pipe Size<br/>(inches)</b> | <b>PVC &amp; PVCO "Push on"<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> | <b>Ductile Iron "Push on"<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> | <b>Ductile Iron Mechanical<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> |
|---|--|--|---|
| 4   | 4  | 19   | 27  |
| 6   | 4  | 19   | 27  |
| 8   | 4  | 19   | 20  |
| 10  | 4  | 19   | 20  |
| 12  | 4  | 19   | 20  |
| 14  | 0  | 11   | 13  |

| <b>Nominal<br/>Pipe Size<br/>(inches)</b> | <b>PVC &amp; PVCO “Push on”<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> | <b>Ductile Iron “Push on”<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> | <b>Ductile Iron Mechanical<br/>Joint Maximum<br/>Deflection<br/>(inches/18-foot length)</b> |
|---|--|--|---|
| 16  | 0  | 11   | 13  |
| 18  | 0  | 11   | 13  |
| 20  | 0  | 11   | 11  |
| 24  | 0  | 11   | 9   |

### 3.07 Jointing

#### A. Fittings

Mechanical and "push on" joints shall be installed in accordance with the joint manufacturer's recommendations. Copies of such recommendations shall be furnished to the Owner prior to the start of construction.

Flange faces of flanged joints shall be thoroughly cleaned with a wire brush and the pipe carefully aligned. The gasket shall then be inserted between the flanges and the bolts and nuts installed. Tightening of the bolts shall be done evenly around the flange so as to uniformly distribute the stress carried by the bolts.

#### B. Butt Fusion

Joints for pipe shall be by thermal butt fusion per ASTM D2657. All joints shall be performed in accordance with the procedures recommended by the manufacturer.

### 3.08 Tracer Wire

A tracer wire shall be laid along the crown of any plastic pipes. The wire shall be attached to the top of the pipe in such a manner that it will not become displaced during construction and backfilling. Tracer wire shall be continuous (without splices) over each separate run. If wire is damaged or broken during installation, a new wire shall be installed by the Contractor. The wire shall be terminated in valve wells or boxes as approved by the Owner.

### 3.09 Backfilling

Backfilling shall be in accordance with Section 31 23 02 – Excavating and Backfilling for Utility Construction.

### 3.10 Separation and Cover

Where the proposed water main crosses under an existing utility, the proposed water main shall be deflected above or below the existing utility in accordance with the following:

- A. Maintain a minimum depth of cover over top of proposed water main as shown on the drawings.
- B. Maintain at least 18 inches of vertical separation and 10 feet of horizontal separation between the outside of the proposed water main and the outside of a sewer, drain pipe, or catch basin lead.

- C. Maintain at least 1 foot of vertical separation between the outside of the proposed water main and the outside of an existing utility other than a sewer, drain or catch basin lead.
- D. When crossing an existing sewer, drain pipe, or catch basin lead, construct the proposed water main so that its joints are equidistant from the utility being crossed.

### 3.11 Hydrants and Valves

#### A. Setting Valves

Valves shall be examined by the Contractor prior to lowering in the trench. All nuts and bolts shall be checked to assure tightness.

Valves shall be installed with the valve closed, supported on two 2-inch by 6-inch by 18-inch hardwood blocks and vertically plumb. The valve box shall be set plumb and its axis shall be in line with the stem. Valve boxes shall have the ability for future adjustments of up to 6 inches, above or below grade.

### 3.12 Polyethylene Encasement

All ductile iron fittings and hydrants below grade shall be wrapped with polyethylene encasement. Installation shall be as set forth in ANSI A21.5/AWWA C105 and DIPRA's "Polyethylene Encasement" brochure.

### 3.13 Thrust Restraint

All tees, plugs, bends, hydrants, offsets, and similar fittings shall be mechanically restrained or braced to undisturbed ground by use of concrete thrust blocks.

Concrete for use as thrust blocks shall have a 28-day compressive strength of not less than 3,000 psi. The thrust block shall be placed so that the pipe, valve, hydrant, or fitting joints are accessible for repair. Details of placement of thrust blocks are shown on the plans. Vertical bends will require blocking and strapping as shown on the plans.

Restrained joints shall be designed in accordance with DIPRA *Thrust Restraint Design for Ductile Iron Pipe*. The following restraint joint systems are approved for ductile iron pipe, when observed by the Owner.

| Pipe Size           | Restrained Joint Type |
|---------------------|-----------------------|
| 12 inch or less     | Field Lok, Fast Grip  |
| 16 inches or larger | FlexRing, TR Flex     |

Restrained joints for PVC and PVCO pipe shall be as follows:

- A. MEGALUG by EBAA Iron, Series 19MJ00 or approved equal for mechanical joint restraints.
- B. MEGALUG by EBAA Iron, Series 1900 or approved equal for push joint/bell restraints.

Restrain all mechanical joints with retainer glands. Restraint all joints within length(s) according to restraint schedule, as determined using EBAA Iron Restraint Length Calculator.

Restrained joints are considered included in work of water main construction and will not be paid for separately.

### 3.14 Connection of Polyethylene to Fixed Appurtenances for Fittings

All connections where PE water main is transitioned to a different type of piping material or fitting, the pipe shall be anchored in concrete at the connection of the PE to the existing or proposed line or fitting. Concrete for use as anchor blocks shall have a 28-day compressive strength of not less than 3,000 psi. A flanged HDPE fitting shall be butt fused at the location of the transition of differing materials and encased in concrete.

### 3.15 Water Services

Water services shall be constructed where shown on the plans or where directed by the Owner.

Water service pipe shall be connected to the water main through a brass corporation stop.

Water service pipe shall be connected to the water main through a service clamp or saddle (except where direct tapping is permitted) and brass corporation stop. The water main shall be under pressure during the tapping process. The pipe shall be drilled and tapped to the appropriate size for the connection being installed. The service clamp or saddle shall provide full support around the circumference of the pipe, and have a bearing area of sufficient width along the length of the pipe so that the pipe will not be distorted when the saddle is tightened. U-bolts will not be permitted.

Ductile iron pipe may be direct tapped in accordance with the following tables. Direct taps shall be drilled and tapped under pressure by use of a tapping machine with a combination drill and tap of the appropriate size for the connection being installed.

| <b>Minimum DIP Thickness Class Required for Direct Tapping</b> |                 |           |            |            |           |
|--|-----------------|-----------|------------|------------|-----------|
| <b>Water Main<br/>Diameter<br/>(inches)</b>                    | <b>Tap Size</b> |           |            |            |           |
|  | <b>¾"</b>       | <b>1"</b> | <b>1¼"</b> | <b>1½"</b> | <b>2"</b> |
| 4  | 53              | 55        |            |            |           |
| 6  | 51              | 53        | 55         |            |           |
| 8  | 50              | 52        | 53         | 55         |           |
| 10   | 50              | 51        | 52         | 53         |           |
| 12   | 50              | 50        | 51         | 52         | 55        |
| 16   | 50              | 50        | 50         | 50         | 54        |
| 20   | 50              | 50        | 50         | 50         | 52        |
| 24   | 50              | 50        | 50         | 50         | 50        |

| Minimum Pressure Class of DIP Required for Direct Tapping |          |     |     |     |     |
|---|----------|-----|-----|-----|-----|
| Water Main Diameter (inches)                              | Tap Size |     |     |     |     |
|   | ¾"       | 1"  | 1¼" | 1½" | 2"  |
| 4   |          |     |     |     |     |
| 6   |          |     |     |     |     |
| 8   | 350      |     |     |     |     |
| 10  | 350      |     |     |     |     |
| 12  | 350      |     |     |     |     |
| 16  | 250      | 250 | 250 | 300 | 350 |
| 20  | 250      | 250 | 250 | 250 | 250 |
| 24  | 250      | 250 | 250 | 250 | 250 |

PVC and PVCO pipe shall not be direct tapped. Services 2 inches and under shall utilize a service saddle.

The maximum service connection for PVC and PVCO pipe is 2 inches.

After tapping the main and installing the corporation stop, the tap shall be tested by turning the corporation on and off. Any leakage detected visually shall be corrected by the Contractor.

The water service pipe shall be laid such that there is at least 24 inches of slack in the service line at the main. In other words, the first 3 feet of trench adjacent to the main shall have at least 5 feet of service lead pipe laid in it.

All joints of copper pipe shall be flared joints. After the copper pipe is in place and connected to the curb stop, the line shall be visually checked for leaks by closing the curb stop and opening the corporation stop.

The Contractor shall leave the corporation stop in the open position, unless directed otherwise by the Owner.

The excavation resulting from water service pipe construction or reconnections and within the 1:1 influence of a roadway, driveway, sidewalk, parking lot, railroad, or other structures shall be backfilled by the Contractor with sand and compacted. Excavations not within the 1:1 influence of structures or paved surfaces may be backfilled with suitable native soils and shall be compacted.

Water service pipe shall be buried to the depth shown on the plans for water main depth, unless otherwise directed by the Owner.

### 3.16 Conflicts with Existing Utilities

Excavation shall be made sufficiently in advance of pipelaying operations so that water main alignment can be adjusted to go above, below, or around existing pipes, structures, cables, or other obstacles that are encountered. Where such minor adjustments are made to the water main alignment, no additional compensation will be due to the Contractor.

Where existing electric cables, telephone cables, gas mains, or services are damaged, repairs shall be at the Contractor's expense. The repairs shall be made by the appropriate utility.

Where sewer leads are damaged, they shall be repaired by the Contractor at no charge to the Owner. Sewer leads shall be repaired with a section of schedule 40 PVC pipe of the size encountered. Pipe of the same material as that encountered can also be used. The damaged pipe shall be cut square and the "connection" area shall be thoroughly cleaned. Rubber gasketed sleeve couplings, suitable for connecting the pipe sizes and materials encountered, shall be furnished and installed by the Contractor for each reconnection or repair joint.

### 3.17 Conflicts with Proposed Utilities

This work consists of relocating a portion of existing water main or water service to avoid a conflict with a proposed utility. This work includes furnishing all labor, equipment, and materials required for excavation, installation, disinfection, and backfilling as shown on the plans and specified within this specification.

### 3.18 Restoration

Areas disturbed by construction activities shall be restored by the Contractor.

### 3.19 Testing and Disinfection

#### A. Hydrostatic Pressure Testing for Water Main

Water main shall be hydrostatically tested immediately after the section to be tested is installed. The Contractor shall provide all labor, equipment, and materials to perform the test, including pumps, gauges, plugs, corporations, water, miscellaneous pipes and fittings, and a means of measuring lost water. The testing equipment shall be approved by the Owner.

The Contractor shall fill the main through hydrants or corporations. After completion of the tests, corporations made for the purpose of testing shall be plugged. Water shall be added to the line and air expelled to provide a pressure of 150 psig. When the Contractor has verified that all air is expelled and that the test pressure is maintained, the Contractor shall notify the Owner to witness the test. The Owner shall be given at least a 24-hour notice. The test duration shall be two hours. Water shall be added during the test period, as required, to maintain the required pressure to the highest point in the system throughout the test period. The amount of water required to maintain the test pressure is the actual leakage.

The actual leakage shall not exceed the allowable leakage as tabulated below:

| <b>Pipe Size<br/>(inch)</b> | <b>Allowable Leakage<br/>per 1,000 feet of Water Main<br/>(gallons/2 hours)</b> |
|-----------------------------|---|
| 6                           | 1.00  |
| 8                           | 1.32  |
| 10                          | 1.66  |
| 12                          | 1.98  |

| <b>Pipe Size<br/>(inch)</b> | <b>Allowable Leakage<br/>per 1,000 feet of Water Main<br/>(gallons/2 hours)</b> |
|-----------------------------|---|
| 16                          | 2.64  |
| 20                          | 3.32  |
| 24                          | 3.98  |

If unsatisfactory results are obtained, the Contractor shall locate and repair the leak and the system shall be retested.

**B. Tracer Wire Continuity**

The Contractor shall demonstrate continuity of the installed tracer wire to the Owner.

**C. Disinfection**

The Contractor shall flush the water main with potable water until discharge from the main runs clear. The main shall be chlorinated in accordance with AWWA C651. After the chlorination procedure is completed, the water main shall be flushed again until the chlorine content is equal to that of the water being supplied. Sixteen hours or longer after the flushing, the Contractor may begin collecting samples for bacteriological analysis. Samples shall be collected at 24-hour intervals until two consecutive satisfactory results are obtained. Samples shall be collected at the end opposite the chlorine injection, except that in long lines or where contamination is suspected, the Owner may require other sampling points. Sampling shall be performed under the observation of the Owner.

Where satisfactory results are not obtained, the main shall be reflushed, redisinfected, and retested. Heavily chlorinated water shall be disposed of properly.

\*\*\*END OF SECTION\*\*\*



SECTION 33 31 00  
SANITARY SEWER

PART 1 - GENERAL

1.01 Work Included

The Contractor shall supply all labor, material, and equipment required for the installation and testing of gravity sanitary sewers and appurtenances in compliance with these general specifications, project specifications, and the contract drawings.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM A48 – Standard Specification for Gray Iron Castings
- B. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- D. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- E. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- F. ASTM C1479 – Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
- G. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- H. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- I. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- J. ASTM D2680 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
- K. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- L. ASTM D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials
- M. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

- N. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
- O. ASTM F1668 – Standard Guide for Construction Procedures for Buried Plastic Pipe
- P. ANSI A21.4/AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- Q. ANSI A21.5/AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems
- R. ANSI A21.10/AWWA C110 – Ductile-Iron and Gray-Iron Fittings
- S. ANSI A21.11/AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- T. ANSI A21.51/AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast
- U. ANSI A21.53/AWWA C153 – Ductile-Iron Compact Fittings
- V. Michigan Department of Transportation 2020 Standard Specifications for Construction

#### 1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 01 55 26 – Maintaining Traffic
- C. Section 01 71 23.16 – Construction Staking by Contractor
- D. Section 01 74 50 – Cleanup and Restoration
- E. Section 31 10 01 – Clearing and Removal of Miscellaneous Structures
- F. Section 31 23 02 – Excavating and Backfilling for Utility Construction
- G. Section 31 25 00 – Soil Erosion and Sedimentation Control
- H. Section 32 92 00 – Turf Establishment

#### 1.04 Submittals

The Contractor shall submit shop drawings or certificates of compliance to the Owner for the following items.

- A. Pipe, fittings, and joint material
- B. Manholes and manhole adjusting rings and castings
- C. Pipe bedding and backfill material

#### 1.05 Quality Assurance and Quality Control

##### A. Grade and Alignment

Grade and alignment shall be maintained using a laser. The Contractor shall verify that the sewer is constructed at the proper alignment by checking grades and offsets at each manhole, at 50 feet upstream from manholes, and at 100-foot intervals. The Contractor shall report as-constructed measurements to the Owner.

#### B. Acceptance Tests

The completed sewer(s) shall be subjected to the following tests, prior to acceptance by the Owner. Acceptance tests shall be completed by the Contractor, in the presence of the Owner (or Owner's representative).

##### 1. Infiltration Tests

The infiltration test shall be completed in accordance with Section 3.09.A.

##### 2. Air Test

Air testing shall be completed in accordance with section 3.09.B.

##### 3. Deflection Testing

All plastic sewers shall be subjected to a deflection test in accordance with Section 3.09.C.

##### 4. Physical Inspection

The physical inspection shall be completed in accordance with Section 3.09.D.

### PART 2 - PRODUCTS

#### 2.01 Materials

All material supplied shall be new and shall be designed and guaranteed to perform the service required.

##### A. Pipe

Pipe shall be of the material, class and/or thickness indicated on the plans or on the proposal. If no specific materials or classes are provided on the plans or on the proposal, any of the following pipe materials are permissible.

##### 1. PVC Pipe

All PVC pipe shall be ASTM D3034 gasketed sewer pipe with an SDR of 26 or lower and conform to ASTM D2321. PVC pipe conforming to ASTM D1785 Schedule 40 and ASTM D2665 is acceptable for 6-inch service leads.

##### 2. PVC Truss Pipe

Truss pipe shall conform to ASTM D2680. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, or other defects. Fittings shall conform to ASTM D2680 Section 7.1 and Tables 5 and 6. Joints shall be made with gasketed bell coupling connections. Elastomeric seals (gaskets) shall meet ASTM F477 requirements.

##### 3. Ductile Iron Pipe

Pipe shall be ductile iron Class 53, manufactured in accordance with the requirements of ANSI A21.51/AWWA C151. Push on joints for the pipe shall be in accordance with ANSI A21.11/AWWA C111. Pipe shall have cement mortar lining and seal coating in accordance with ANSI A21.4/AWWA C104.

Polyethylene wrap shall be in accordance with ANSI A21.5/AWWA C105 and shall be provided for all pipes except for those in manholes.

Fittings shall be mechanical joint or push-on type, either cast iron or ductile iron as follows: Cast iron fittings shall meet the requirements of AWWA C110 and shall be rated for 350 psi working pressure. Ductile iron fitting shall meet the ANSI A21.53/AWWA C153 and shall be Class 350. Fittings shall be cement lined in accordance with ANSI A21.4/AWWA C104. Rubber gasket joints shall meet ANSI A21.11/AWWA C111. Electrical conductivity shall be provided at each joint.

4. Reinforced Concrete Pipe

Where specified on the drawings, all sanitary sewers 18 inches or larger shall be reinforced concrete pipe conforming to ASTM C76, with joints conforming to ASTM C443. The size and class shall be as shown on the drawings. If the class is not shown on the drawings, Class III pipe shall be used when the cover over the pipe is 16 feet or less; Class IV pipe shall be used when the cover over the pipe is between 16 feet and 23 feet; and Class V pipe shall be used when the cover over the pipe is 23 feet or more.

B. Drop Connections

Pipe and fittings for drop connections shall be PVC or ductile iron.

2.02 Material Testing

All materials to be incorporated in the construction of gravity sewers and appurtenances shall be subject to inspection and tests, as specified by ASTM or AWWA references. The Owner reserves the right to subject any material supplied for a particular project to an independent testing laboratory. Such tests, if scheduled, shall be paid for by the Owner. The results of such tests shall be the basis of material acceptance.

The Contractor shall supply the Owner with shop drawings, a certificate of compliance, or actual test results stating that the material to be used is in conformance with the specifications prior to using material for construction.

PART 3 - EXECUTION

3.01 General

Sewers shall be constructed in accordance with the following standards, except as modified in this specification:

A. Concrete Pipe: ASTM C1479

B. Plastic Pipe: ASTM F1417 and ASTM F1668

3.02 Excavation

Excavation shall be completed in accordance with Section 31 23 02 – Excavating and Backfilling for Utility Construction.

### 3.03 Pipe Alignment

It shall be the Contractor's responsibility to transfer the line and grade to the bottom of the excavation for pipe laying. Lasers shall be used for pipe laying.

It shall be the Contractor's responsibility to protect the original survey control and benchmarks, as set by the Owner.

### 3.04 Pipe Laying

Each pipe shall be laid on an even, firm bed, so that no uneven strain will come to any part of the pipe. Particular care shall be exercised to prevent the pipes bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each point as specified before. Each pipe shall be laid in the presence of the inspector. The bell-end of the pipe shall be laid up-grade. Pipe laying shall proceed in the upstream direction, except where otherwise approved by the Owner.

The interior of the sewer shall be cleaned of all dirt, debris, jointing material, and other material.

All pipe shall be completely pushed to the "home" position.

Pipes laid in tunnel or casing pipe shall be supported on suitable blocks, cut or grouted into position to place the invert of the sewer or drain at the slope, and to the elevations indicated on the contract drawings.

### 3.05 Connections to Existing Sewers

When replacing an existing sewer or manhole or constructing a new manhole over an existing sewer, the original sewer shall be reconnected to the new sewer or manhole. Existing sewer pipe shall be removed, salvaged, and reused to make connection to the new manhole, if possible. If existing pipe is not salvageable, a new sewer pipe shall be installed, as required, and connected to the existing sewer. When a new sewer is connected to an existing sewer, the existing sewer shall be removed to an existing joint, if existing joint is compatible with new sewer. If existing sewer joint is not compatible with new sewer, a watertight coupler shall be installed.

### 3.06 Pipe Joints

In all jointing operations, the trench must be dewatered when joints are made. Bell and spigot or tongue and groove ends of the pipe shall first be wiped clean before actual jointing operations are started.

Joints between consecutive bell and spigot or tongue and groove pipe shall be made with a rubber gasket. The gasket shall be fitted over the tongue or spigot of each pipe, as recommended by the manufacturer, and the pipe entered into the bell or groove and shoved home.

#### A. PVC Joints

All PVC pipe shall be joined with rubber compression gaskets that are factory installed. The joint shall be lubricated and joined so the "home" mark on the pipe is flush with the bell end.

B. Joints for Reinforced Concrete Pipe

Both the bell and spigot ends of the pipes to be joined shall be cleaned. The rubber joint shall be lubricated with material furnished by the joint manufacturer. The spigot end of the pipe shall be pushed "home" into the bell end of the receiving pipe.

3.07 Connections for Service Pipes

Service connections for house sewers shall be provided in the main sewers, as shown on the contract drawings or as designated in the specifications. The exact location shall be as directed by the Owner during construction.

Either tee or wye branches are acceptable for service connections, where the main line sanitary sewer is 12 inches or greater. Wye fittings are required on 8-inch and 10-inch sewers. Service leads shall be installed at a sufficient depth to service house basements if the main line sewer is sufficiently deep, but shall be left above the water table at their terminus.

The Contractor shall place a hardwood stake on the property line directly opposite each opening left in the sewer. The hardwood stake shall be 8 feet long and a minimum size of 2 inches by 2 inches. The Contractor shall locate and keep a record, in tabular form, of all manhole and sewer opening locations by measurement to the nearest downstream opening. All manhole locations shall be witnessed by at least two ties to existing topographic features. This record shall be delivered to the Owner during the progress of the work. When constructing sanitary sewer connections in wet ground, place a 45-degree bend at the property end of the connection and install enough house lead to bring the connection above the natural ground water level.

For service connections where the main line is less than 10 feet deep, the Contractor need not supply a riser connection for the service lead. The service connection shall be left at a depth of 8 feet to 10 feet below the ground at the property line. The Contractor has the option of installing the house lead at an incline or using a riser section for sewers less than 10 feet deep.

When the invert of the sanitary sewer is in excess of 10 feet, a riser section shall be used to raise the service connection to a point approximately 10 feet below the surface of the ground. All service connections shall be installed in accordance with the standard details.

All openings shall be plugged with air tight stoppers.

Service leads on easements or adjacent to property lines shall extend one pipe length from the main line sewer, but not beyond the easement limit.

3.08 Backfill

Backfill shall meet the requirements of Section 31 23 02 – Excavating and Backfilling for Utility Construction.

3.09 Acceptance Tests - Sanitary Sewers

The methods of testing shall be approved by the Owner. The Contractor shall provide the necessary equipment and labor for making the tests, and the cost of testing and repair shall be

included in the unit price bid for completed sanitary sewer. The Owner shall determine when grouting or relaying of faulty pipe is required.

A. Infiltration Testing

Sewers 24 inches and larger shall be subjected to an infiltration test. Infiltration into the sanitary sewer shall be measured by use of an infiltration manhole where called for on the plans or by a V-notched sharp crested weir. The weir shall be furnished and installed by the Contractor, as directed by the Owner. The joint shall be tight and visible leakage in the joints or excess of the specified amount shall be repaired at the Contractor's expense.

There shall be no allowable infiltration for PVC sanitary sewer pipe. The maximum amount of allowable leakage for other sanitary sewer pipe materials shall be limited to 100 gallons per inch diameter, per mile, per 24-hour day. The maximum allowable leakage shall be limited to 1,200 feet test length. The Contractor may elect to test longer sections of pipe, but the maximum allowable leakage shall be calculated based on a 1,200-foot test length. All testing shall be monitored by the Owner.

B. Air Testing

Sewers less than 24 inches in diameter shall be subjected to an air test. The Contractor shall furnish all necessary labor, equipment, and supervision to perform the required air testing. The testing of PVC pipe sewer shall conform to ASTM F1417.

The Contractor shall be required to furnish the Owner with acceptable air test results for each segment of sanitary sewer. All testing shall be monitored by the Owner.

The procedure for air testing of sewers shall be as follows:

The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an air-tight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3½ inches and a range of 0-10 psig. The gauge shall have minimum divisions of 0.10 psig and an accuracy of plus or minus 0.04 psig.

The sewer shall be pressurized to 4 psig, plus sufficient pressure to equal the force exerted by ground water over the pipeline. At least 2 minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 psig. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 psig or greater.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 psig, or such other pressure as is necessary to compensate for ground water level.

The time required for the air pressure to decrease 1 psig during the test shall not be less than the time shown in the following table:

| <b>Pipe Diameter<br/>(inches)</b> | <b>Minimum Test<br/>Time (minutes)</b> | <b>Pipe Length for<br/>Minimum Time (feet)</b> | <b>Time for Longer Pipe<br/>Length (seconds)</b> |
|-----------------------------------|--|--|--|
| 4                                 | 3:46                                   | 597  | 0.380 L  |
| 6                                 | 5:40                                   | 398  | 0.854 L  |
| 8                                 | 7:34                                   | 298  | 1.520 L  |
| 10                                | 9:26                                   | 239  | 2.374 L  |
| 12                                | 11:20                                  | 199  | 3.418 L  |
| 15                                | 14:10                                  | 159  | 5.342 L  |
| 18                                | 17:00                                  | 133  | 7.692 L  |
| 21                                | 19:50                                  | 114  | 10.470 L   |

Length is based on the length of the sewer main only. If laterals or other leads are connected, their lengths are not to be included in the testing length.

If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them, and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

#### C. Deflection Testing

All sanitary sewers constructed using plastic pipe shall be subjected to a deflection test. The Contractor shall furnish all labor, materials, and equipment necessary to perform deflection testing. The testing shall be completed after the pipeline has been backfilled for a period of at least 30 days. The pipeline shall be tested with a rigid ball or mandrel having at least 7 points, and having a diameter of not less than 95 percent of the average inside diameter of the pipe being tested. The average diameter for the pipe will be as specified by the ASTM specification for the pipe material, class, and size. Where testing indicates that the pipe deflection exceeds 5 percent of the pipe diameter, the pipe shall be removed and replaced. Pipe that is replaced shall be re-tested at least 30 days following its replacement.

Deflection testing shall be performed in the presence of the Owner. The Contractor shall provide the Owner with a least two working days' notice of conducting deflection testing.

#### D. Physical Inspection

Upon completion of all work, the Contractor shall open all manholes in the presence of the Owner to demonstrate that the manholes are complete and free of debris.

### 3.10 Bypass Pumping

Bypassing of the existing sewage shall be provided, as required, to maintain uninterrupted sanitary sewer service. The line shall be plugged at an upstream manhole and the flow shall be pumped to a downstream point or adjacent system. The pump and bypass lines provided shall be of sufficient size to handle the normal and peak flow conditions for the system. Internal combustion engines shall have adequate exhaust silencers to muffle engine noise to an acceptable level for the area where located.



The bypass plan for each segment of pipe shall be submitted to the Owner for review and approval prior to the start of the project, along with a list of equipment. All property owners affected by the bypass shall be notified by the Contractor a minimum of 48 hours in advance.

\*\*\*END OF SECTION\*\*\*

SECTION 33 44 00  
STORM SEWERS

PART 1 - GENERAL

1.01 Work Included

This work includes construction of storm sewers, drainage structures, and appurtenances. Drainage structures include catch basins, inlets, manholes, and manhole tees.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- B. AASHTO M170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe, 300-mm to 1,500-mm (12-in. to 60-in.) Diameter
- D. ASTM A48 – Standard Specification for Gray Iron Castings
- E. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- F. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- G. ASTM C478 – Standard Specifications for Circular Precast Reinforced Concrete Manhole Sections
- H. ASTM D1056 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
- I. ASTM D4101 – Standard Specifications for Polypropylene Injection and Extrusion Materials
- J. Michigan Department of Transportation 2020 Standard Specifications for Construction
- K. Michigan Department of Transportation Standard Plans

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 01 55 26 – Maintaining Traffic
- C. Section 01 74 50 – Cleanup and Restoration
- D. Section 31 23 02 – Excavating and Backfilling for Utility Construction

E. Section 31 25 00 – Soil Erosion and Sedimentation Control

F. Section 32 92 00 – Turf Establishment

1.04 Quality Assurance and Quality Control

A. Grade and Alignment

Grade and alignment shall be maintained using a laser. The Contractor shall verify that the sewer is constructed at the proper alignment by checking grades and offsets at each manhole, at 50 feet upstream from manholes, and at 100-foot intervals. The Contractor shall report as-constructed measurements to the Owner.

B. Acceptance Tests

The completed sewer(s) shall be subjected to the following tests, prior to acceptance by the Owner. Acceptance tests shall be completed by the Contractor, in the presence of the Owner (or Owner's representative).

1. Internal Video Inspection

The video inspection shall be completed in accordance with Section 3.08.A.

2. Physical Inspection

The physical inspection shall be completed in accordance with Section 3.08.B.

PART 2 - PRODUCTS

2.01 Materials

A. Pipe

Unless a specific type, class or thickness is called for on the plans or in the proposal, material class shall meet the requirements of Pipe Alternates for Storm Sewer Classes, as described in Section 402 of the Michigan Department of Transportation 2020 Standard Specifications for Construction. Corrugated steel pipe may be used only where shown on the drawings.

1. Reinforced Concrete Pipe

Pipe shall meet ASTM C76. Where no class is shown on the drawings or on the proposal, Class III or better shall be provided.

Joints shall be rubber gaskets in accordance with ASTM C443.

Reinforced concrete pipe to be installed by jacking shall be Class V and shall be provided with full circular reinforcement. Pipe joints shall be butt type.

2. Smooth-Lined Corrugated Plastic Pipe

Where storm sewers from 12-inch to 24-inch diameter are called for on the plans, with at least 3 feet of cover over the pipe, and when a particular kind of sewer pipe is not specified, the Contractor may furnish smooth-lined corrugated plastic pipe (SLCPP).

SLCPP shall be corrugated polyethylene pipe meeting the requirements of AASHTO M294, Type S. Any fittings required shall also meet the requirements of AASHTO M294. Only fittings supplied or recommended by the pipe manufacturer shall be used. When gaskets

are used in couplings to provide watertight or silt-tight joints, gaskets shall be a band of expanded rubber meeting the requirements of ASTM D1056 for Type 2 closed cell rubber, or O-rings meeting the requirements of ASTM C443.

3. PVC Pipe

All PVC pipe shall be ASTM D3034 gasketed sewer pipe with a SDR of 26 or lower. PVC pipe conforming to ASTM D1785 Schedule 40 and ASTM D2665 is acceptable for 6-inch service leads.

4. Corrugated Galvanized Steel Pipe

Pipe with circular cross section and reformed pipe with pipe arch shape shall conform to AASHTO M36. The Contractor shall furnish the Owner with two copies of a certification of compliance, with the chemical requirements of the base metal, as specified in AASHTO M36.

Corrugated metal pipe shall be a minimum of 8-gauge or wall thickness of 0.168 inches.

For pipe arch shapes, minimum thickness shall be based on the next larger size if the actual span dimension is not listed.

B. End Sections

End sections shall be flared and beveled to conform with ditch slopes.

Metal end sections shall conform with AASHTO M36, where applicable. The metallic coating on the end sections shall be the same as on the pipe. End sections shall be furnished complete with coupling bands or hardware necessary for connecting them to the end of the pipe culvert.

Concrete end sections shall be constructed of precast concrete and reinforcement conforming to the requirements of AASHTO M170 (ASTM C76) Class III or as shown on the drawings. Connection of end section to concrete pipe shall be made by tongue and groove joints.

C. Drainage Structures

Drainage structures shall be precast concrete units meeting the requirements of ASTM C478 with rubber gaskets conforming to ASTM C443. Drainage structures shall be 4 feet in diameter, unless shown otherwise on the plans or in the proposal. Precast concrete grade rings meeting ASTM C478 shall be used to adjust the top of the structure to the final grade. At least 6 inches, but not more than 18 inches, of vertical adjustment shall be provided with grade rings. Manhole lifting holes shall not be permitted in the manhole sections. Lifting lugs shall be cast into the manhole for lifting.

Manhole steps shall be copolymer polypropylene plastic steps with a steel reinforcement bar, with a minimum diameter of ½-inch, a minimum width of 10 inches center to center of wall anchor, and complete with anti-skid side plates conforming to ASTM D4101. Steps shall be manufactured with the manhole wall and spaced at a maximum of 16 inches on center. Gray iron castings shall be heavy duty classification and shall conform to ASTM A48 Class 35B coated with asphalt coating.

#### D. Castings

Castings shall meet the requirements of the Michigan Department of Transportation 2020 Standard Specifications for Construction, and the Michigan Department of Transportation Standard Plans.

### PART 3 - EXECUTION

#### 3.01 Excavation

Excavation shall be completed in accordance with Section 31 23 02 – Excavating and Backfilling for Utility Construction.

#### 3.02 Pipelaying

Sections of sewer pipe shall be carefully laid in the prepared trench, bell ends upgrade, with the spigot end fully entered in the adjacent bell. Each section shall have firm bearing throughout its length and shall be substantially true to the line and grade required. The use of blocks to bring sections to grade will not be permitted.

Circular concrete pipe with lift holes shall be installed with the lift holes on top of the pipe. Holes shall be plugged with suitable concrete plugs before backfilling.

Existing live sewers that are to remain shall be carefully protected during construction of the new sewers. If they are damaged in any way, they shall be immediately repaired or replaced, as directed by the Owner.

All junctions with house or building leads shall be made in a manner acceptable to the Owner.

Flexible watertight joints shall be installed in accordance with the manufacturer's recommendations.

Connections to sewers owned by other agencies shall be done in accordance with their requirements.

Connections to existing sewers having a plug or bulkhead shall be made with a watertight joint. The plug or bulkhead shall be removed without damage to the sewer, and the plug material shall be removed from the sewer and properly disposed of.

If there are no openings in the existing pipe or structures at the point of connection, an opening shall be cut in the pipe or the structure sufficiently large enough to permit 3 inches of mortar to be packed around the entering pipe and the mortar pointed up smooth and flush with the inner wall. Pipe passing through pipe or structure walls shall be cut at the end to conform with the shape of the inside of the wall and to be flush therewith. On the outside of the pipe or structure, the entering pipe shall be encased with sufficient mortar to provide bearing under the pipe. Any existing pipe broken or cracked while making the connection shall be replaced at the Contractor's expense.

When replacing an existing sewer, connections to the original sewer or drain that are encountered shall be reconnected to the new sewer.

Sewers and drainage structures shall be reasonably free of accumulation of silt debris and other foreign matter at the time of final acceptance.

### 3.03 Backfill

Backfill shall meet the requirements of Section 31 23 02 – Excavating and Backfilling for Utility Construction.

### 3.04 Additional Requirements of Construction for SLCPP Sewers

SLCPP shall be installed in accordance with Section 3.01. and the additional requirements provided here.

Joints in SLCPP shall be wrapped with a 2-foot wide strip of non-woven geotextile filter fabric with a 1-foot lap at the fabric joint.

The installed pipe shall not be deformed such that any diameter is reduced by 5 percent or more. Deformed pipe shall be removed and replaced at the Contractor's expense. The completed pipeline shall be tested for deformation by the Contractor under the Owner's supervision. The Contractor shall furnish a 9-point mandrel having a diameter equal to at least 95 percent of the original uninstalled inside diameter of the pipe. The mandrel shall meet the Owner's approval. Mandrel testing shall be performed no less than thirty calendar days after installation.

### 3.05 Additional Requirements for Construction of Corrugated Steel Pipe Sewers

#### A. Repair of Damaged Galvanized Surfaces

The Contractor shall take special care when removing, salvaging, storing, handling, or placing new culverts or culverts that are to be relaid so that they are not dented, scraped, or the galvanized coating is otherwise damaged.

Large diameter or long culverts shall be provided with shop attached lift rings to facilitate handling. Lift holes shall not be cut in corrugated steel pipe.

Saw cut ends of corrugated steel pipe shall be reasonably free from excessive jagged burrs or sharp spurs.

Surfaces on which the spelter coating has been damaged, whether by transporting, handling, or installation, shall be thoroughly cleaned by wire brushing and then painted with two (2) coats of zinc rich paint conforming to federal specification: Paint shall be High Zinc Dust Content, Galvanizing Repair (Ready Mixed Type) MIL-P-21035.

#### B. Laying and Jointing Pipe

All pipe shall be laid true to the lines and grades given. Each length shall have full, firm bearing throughout its length.

Separate sections of corrugated pipe shall be securely joined together with standard corrugated metal bands. The bands may be up to 2 standard thicknesses lighter than the culvert, but shall not be less than 0.64 inches (16-gauge). Bands for culverts shall not be less than the following widths:

| <b>Pipe Diameter</b>        | <b>Band Minimum Width</b> |
|-----------------------------|---------------------------|
| up to & including 18 inches | 7 inches                  |
| 21 inches through 60 inches | 12 inches                 |
| over 60 inches              | 24 inches                 |

The corrugations of the band shall match those of the pipes being joined. The band shall be secured with bolts and angles. Couplings may be either one piece or two pieces. Smooth coupling bands, dimpled bands, and helical-rod and lug bands will not be considered acceptable.

### 3.06 End Sections

End sections shall be attached to the ends of pipe, where directed. Metal end sections shall be used on metal pipe and on smooth lined plastic pipe. Concrete end sections shall be used on concrete pipe.

End sections shall be installed on firm ground. The slope adjacent to the end section shall be graded and shaped to meet the geometry of the end section.

### 3.07 Drainage Structures

Precast concrete units shall be placed on a 6-inch sand base, leveled, and thoroughly compacted. Joints shall be sealed with mortar. Joints shall be thoroughly wetted prior to sealing. The joints inside the structure shall be flush with the walls. Joints shall be completely filled with mortar.

Pipe or tile connections to concrete drainage structures shall extend through the structure wall and be cut flush with the inside surface. The opening around the pipe shall be neatly filled with mortar to prevent leakage.

Drainage structure covers shall be new and adjusted to the finish elevation using precast concrete grade rings. Covers shall be of the type called for on the plans. Covers and grade rings shall be set in full mortar beds.

Cover elevations given on the plans are for information only. The final elevation will be determined in the field, based on as-constructed conditions.

Drainage structures shall be maintained reasonably free of accumulations of silt, debris, and other foreign matter at the time of final acceptance.

### 3.08 Acceptance Tests - Storm Sewers

The methods of testing shall be approved by the Owner. The Contractor shall provide the necessary equipment and labor for making the tests, and the cost of testing and repair shall be

included in the unit price bid for completed storm sewer. The Owner shall determine when grouting or relaying of faulty pipe is required.

A. Alignment, Grade, and Connections

Each section of the storm sewer shall be checked for alignment and grade by using a closed circuit television inspection. The report and video shall indicate the measurements from manhole center to manhole center and shall tabulate all connections. The Contractor shall supply the Owner with a digital recording of the video inspection and a listing of service connections prior to requesting final inspection.

B. Physical Inspection

Upon completion of all work, the Contractor shall open all manholes in the presence of the Owner to demonstrate that the manholes are complete and free of debris.

\*\*\*END OF SECTION\*\*\*



SECTION 33 46 16  
UNDERDRAINS

PART 1 - GENERAL

1.01 Work Included

This work includes constructing a subsurface drainage system.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- B. AASHTO M218 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe
- C. AASHTO M252 – Standard Specification for Corrugated Polyethylene Drainage Pipe
- D. AASHTO M274 – Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
- E. AASHTO M278 – Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
- F. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- G. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- H. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- I. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- J. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- K. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- L. ASTM D4751 – Standard Test Methods for Determining Apparent Opening Size of a Geotextile
- M. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- N. ASTM F949 – Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- O. ASTM F2806 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (Metric SDR-PR)
- P. Michigan Department of Transportation 2020 Standard Specifications for Construction

### 1.03 Related Work

#### A. Section 01 45 16.02 – Density and Aggregate Testing

## PART 2 - PRODUCTS

### 2.01 Materials

#### A. Pipe for Underdrains

##### 1. Smooth Plastic Pipe

Smooth plastic pipe shall be fabricated from polyvinyl chloride (PVC) pipe meeting AASHTO M278, or acrylonitrile-butadiene-styrene (ABS) pipe meeting ASTM F2806, or PVC SDR 35 pipe. Perforations shall meet the requirements of AASHTO M278.

Perforated underdrain pipe shall be wrapped with a non-woven geotextile filter fabric meeting the requirements of Section 2.01 E.

##### 2. Corrugated Plastic Tubing

Corrugated plastic tubing shall conform to AASHTO M252 for polyethylene (PE) tubing or ASTM F949 for polyvinyl chloride (PVC) tubing. Perforations shall meet the requirements of AASHTO M252.

Corrugated plastic tubing shall be wrapped with a non-woven geotextile filter fabric meeting the requirements of Section 2.01 E.

#### B. Pipe for Outlets

Underdrain outlets into storm sewer drainage structures shall be fabricated from either PVC pipe meeting ASTM D1785, Schedule 40 or ASTM D 3034, Type SDR 23.5.

Underdrain outlets into ditches or open watercourses shall be corrugated steel pipe meeting the requirements of AASHTO M36. Pipe shall be fabricated from zinc coated steel sheet conforming to AASHTO M218 or from aluminum coated sheet conforming to AASHTO M274. Pipe wall thickness shall be 0.05 inches or greater.

#### C. Stone

Stone shall be open graded aggregate meeting gradation and requirements of Series 34R, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### D. Sand

Sand shall meet the gradation and requirements of Granular Material Class II, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

#### E. Geosynthetic Fabric

Geosynthetic fabric for trench lining and pipe wrap shall be a non-woven geotextile meeting the following requirements:

| Physical Property                 | Test Method | Physical Requirements |
|-----------------------------------|-------------|-----------------------|
| Grab Tensile Strength (minimum)   | ASTM D4632  | 90 pounds             |
| Trapezoid Tear Strength (minimum) | ASTM D4533  | 45 pounds             |
| Puncture Strength (minimum)       | ASTM D4833  | 45 pounds             |
| Mullen Burst Strength (minimum)   | ASTM D3786  | 140 pounds            |
| Permittivity                      | ASTM D4491  | 0.5 per second        |
| Apparent Opening Size (maximum)   | ASTM D4751  | 0.21 mm               |

### PART 3 - EXECUTION

#### 3.01 Construction

Underdrains shall be constructed where shown on the plans or where directed by the Owner. Underdrain outlets shall be provided where shown on the plans or as necessary to provide positive drainage.

##### A. Trench Excavation

Trenches for underdrain installation shall be excavated using a wheel or chain type trencher, or other method which can excavate to the required depth and grade. The trench width shall be wide enough to accommodate installation of the drain pipe, or as necessary to prevent the trench walls from collapsing.

##### B. Laying Underdrains

Underdrains shall be laid to the line and grade shown on the plans or as directed by the Owner. The trench bottom shall be uniform and provide uniform bearing for the pipe. Two inches of stone shall be laid in the bottom of the trench before the pipe is installed.

The underdrain pipe shall be fitted with the appropriate fittings (end caps, tees, bends, etc.) before the pipe is placed.

##### C. Connections

Joints for fittings and pipe shall be made using mechanical methods, which will prevent separation and not cause an obstruction in the pipe. Joints shall be wrapped with geotextile fabric. The fabric shall be sealed to the pipe with waterproof tape.

##### D. Backfill

Trenches shall not be backfilled until the Owner has observed the installation.

Trenches shall be backfilled with sand. Sand shall be placed around the pipe and to a depth of 6 inches below the top of the curb or pavement. The remaining portion of the trench shall be backfilled with other material according to the plans. Trenches shall be compacted in accordance with Section 01 45 16.02 – Density and Aggregate Testing.

##### E. Underdrain Outlets

Underdrain outlets shall be installed immediately after installation of the underdrains.

Where storm sewers are present, underdrain outlets shall be connected to storm manholes, inlets, and catch basins. The underdrain shall be connected at each storm sewer structure which is available along the length of the underdrain.

Outlets shall be connected to drainage structures by coring a hole through the wall of the drainage structure, at least 4 inches above the invert elevation of the storm sewer pipe outlet. The hole shall be large enough to accommodate the underdrain pipe. The underdrain pipe shall be installed in the cored opening using either a flexible connection or by grouting the void between the pipe and structure wall.

Where storm sewers are not available, underdrain outlets shall be installed at intervals not exceeding 300 feet. Outlet pipes shall be run to the receiving ditch line at a minimum grade of 4 percent. The outlet elevation shall be at least 4 inches above the ditch bottom. A concrete collar shall be formed around the circumference of the outlet pipe. The outside diameter of the collar shall be 12 inches greater than the pipe diameter. The face of the concrete collar shall be sloped, flush with the side slope of the ditch.

\*\*\*END OF SECTION\*\*\*

SECTION 34 41 15  
PERMANENT TRAFFIC SIGNS

PART 1 - GENERAL

1.01 Work Included

This work includes furnishing and installing permanent signs at locations shown on the plans, in the proposal, or as directed by the Engineer in accordance with the Michigan Department of Transportation 2020 Standard Specifications for Construction, the Michigan Manual on Uniform Traffic Control Devices, and as specified herein.

All sign shapes and dimensions shall conform to the Michigan Manual on Uniform Traffic Control Devices.

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Manual on Uniform Traffic Control Devices

1.03 Submittals

The Contractor shall submit shop drawings, catalog cuts, or manufacturer's specifications to show the proposed signs, supports, and hardware.

1.04 Notifications

The Contractor shall contact MISS DIG (800-482-7171) to locate underground utilities in advance of excavating or driving sign posts or foundations. The Contractor shall notify utility agencies which may have underground utilities within the project area to arrange their location.

PART 2 - PRODUCTS

2.01 Materials

Materials for signs and supports shall meet the requirements of Section 919 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

PART 3 - EXECUTION

3.01 Sign Schedule

Signage shall be provided as called for on the plans or in the proposal.

### 3.02 Installation

Signs shall be installed in accordance with Section 810.03 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

\*\*\*END OF SECTION\*\*\*