185 SOUTH STATE STREET
SUITE 800
SALT LAKE CITY, UTAH 84111
801-936-5557

Project Specification Manual

Bid Set
May 12, 2026

MAVERIK – Hardin
1199 Highway 47
Hardin, MT

Project Number: TBD

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SECTION 00 3132 – GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirement of this Project. They provide Owner's information for the 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 this Project follows this Section.

END OF SECTION 00 3132

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CMT TECHNICAL SERVICES



ENGINEERING •GEOTECHNICAL •ENVIRONMENTAL (ESA I & II) •
MATERIALS TESTING •SPECIAL INSPECTIONS •
ORGANIC CHEMISTRY • PAVEMENT
DESIGN •GEOLOGY

GEOTECHNICAL ENGINEERING STUDY

Proposed Maverik Store

Southwest Corner of Dorn Road & Highway 47
Hardin, Montana

CMT PROJECT NO. 20087

FOR:
Anderson, Whalen & Associates
2010 North Redwood Road
Salt Lake City, Utah 84116

May 26, 2023

May 26, 2023

Mr. James Copeland
Anderson, Whalen & Associates
2010 North Redwood Road
Salt Lake City, Utah 84116

Subject: Geotechnical Engineering Study
Maverik Store - Hardin, Montana GEO
Southwest Corner of Dorn Road & Highway 47
Hardin, Montana
CMT Project Number: 20087

Mr. Copeland:

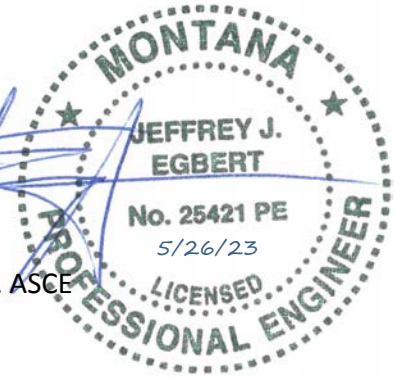
Submitted herewith is the report of our geotechnical engineering study for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

On May 2, 2023, a CMT Technical Services (CMT) staff professional was on-site and supervised the drilling of 6 bore holes extending to depths of about 16.5 to 40 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing and observation.

Conventional spread and/or continuous footings may be utilized to support the proposed structure, provided the recommendations in this report are followed. This report presents detailed discussions of design and construction criteria for this site.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho, Arizona, Colorado and Texas, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-590-0394.

Sincerely,
CMT Technical Services



Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE
Senior Geotechnical Engineer

Reviewed by:

William G. Turner, P.E., M. ASCE
Senior Geotechnical Engineer

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1.0 INTRODUCTION

1.1 General

CMT Technical Services (CMT) was retained to conduct a geotechnical subsurface study for the proposed Maverik convenience store. The site for the proposed development is situated on the south side of Dorn Road and on the west side of Highway 47, adjacent to Interstate 90, in Hardin, Montana, as shown in the **Vicinity Map** below.



VICINITY MAP

1.2 Objectives, Scope and Authorization

The objectives and scope of our study were planned in discussions between Mr. James Copeland of Anderson, Whalen & Associates, and Mr. Andrew Harris of CMT. In general, the objectives of this study were to define and evaluate the subsurface soil and groundwater conditions at the site, and provide appropriate foundation, earthwork, pavement and seismic recommendations to be utilized in the design and construction of the proposed development.

In accomplishing these objectives, our scope of work has included performing field exploration, which consisted of the drilling/logging/sampling of 6 bore holes, performing laboratory testing on representative samples of the subsurface soils collected in the bore holes, and conducting an office program, which consisted

of correlating available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated April 12, 2023.

1.3 Description of Proposed Construction

CMT understands that the proposed construction consists of a new Maverik convenience store and fuel station with accompanying fuel islands, canopies, and underground fuel storage tanks. CMT projects that wall loads for the store building will not exceed 4,000 pounds per linear foot. Floor slab loads are anticipated to be relatively light, with an average uniform loading not exceeding 150 pounds per square foot.

The fuel island canopies will be supported by steel frames and columns extending to the foundation system. It is projected that the maximum canopy downward column loads will be on the order of 60,000 pounds. In addition, uplift and lateral loads will be imposed upon these foundations.

If the structural loading conditions are different than CMT has projected, please notify CMT so that any appropriate modifications to CMT's conclusions and recommendations contained herein can be made.

Parking/drive paved areas will utilize both asphalt and concrete pavement. Concrete pavement will likely be installed in front of the proposed store structure, as well as in the canopy fuel island and over the underground storage tank area. In other areas, asphalt concrete sections will likely be used. Traffic for the medium duty pavement areas is projected to consist of 1,100 automobiles and light trucks per day, and a daily medium-weight delivery truck. The site plan indicates the hi-flow pump island will have 5 lanes, for which Maverik traffic data indicates up to 145 semi-trucks per day.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. The site previously was a cultivated field. Topsoil and/or loose and disturbed surface soils were encountered to approximately 12 to 18 inches in depth.
2. Subsurface soils generally consist of near surface CLAY (CH) layers followed by deeper layers of SAND (SP-SM) and GRAVEL (GP), underlain by Claystone bedrock in places.
3. Groundwater was encountered at depths of about 12 to 15 feet, which will likely affect tank pit excavation.
4. Natural clay soils in at least the upper 5 to 7.5 feet of the subsurface soil profile have a potential to swell when wetted, with swell pressures on the order of 4,500 psf, which could result in upheaval of floor slabs, and possibly footings.
5. Foundations and floor slabs may be constructed on a minimum of 5 feet of non-expansive replacement structural fill, or a minimum of 5 feet of natural clay soils amended with lime to reduce the swell potential, or potentially on a minimum of 5 feet of natural clay soils that have been removed, moisture conditioned to approximately +2% of optimum moisture and recompacted (which will likely be very difficult due to the soils high plasticity and difficulty controlling the moisture content).

CMT must assess that topsoil, undocumented fills (if encountered), debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site are provided, including subsurface descriptions, geologic setting, seismicity, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

2.0 FIELD EXPLORATION

2.1 General

To define and evaluate the subsurface soil and groundwater conditions, 6 bore holes were drilled at the site to depths of approximately 16.5 to 40 feet below the existing ground surface. Exploration depth was limited in a few of the bore holes by either Claystone bedrock or heaving sands. Locations of the bore holes are shown on ***Figure 1, Site Plan***, included in the Appendix. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

Samples of the subsurface soils encountered in the bore holes were collected at varying depths through the hollow stem drill augers. Relatively undisturbed samples were obtained by hydraulically pushing a 3-inch diameter (Shelby) tube or by driving a split-spoon sampler with 2.5-inch outside diameter rings/liners into the undisturbed soils below the drill augers. Disturbed samples were collected utilizing a standard split spoon sampler. This standard split spoon sampler was driven 18 inches into the soils below the drill augers using a 140-pound hammer free-falling a distance of 30 inches. The number of hammer blows needed for each 6-inch interval was recorded. The sum of the hammer blows for the final 12 inches of penetration is known as a standard penetration test and this 'blow count' was recorded on the bore hole logs. Where more than 50 blows occurred before the 6-inch interval was achieved, the sampling was terminated, and the number of blows and inches penetrated by the sampler were recorded. The blow count provides a reasonable approximation of the relative density of granular soils, but only a limited indication of the relative consistency of fine-grained soils because the consistency of these soils is significantly influenced by the moisture content.

The subsurface soils encountered in the bore holes were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM[1] D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Logs of the bore holes, including a description of the soil strata encountered, is presented on each individual Bore Hole Log, ***Figures 2 through 7***, included in the Appendix. Sampling information and other pertinent data and observations are also included on the logs. In addition, a Key to Symbols defining the terms and symbols used on the logs is provided as ***Figure 8*** in the Appendix.

[1] American Society for Testing and Materials

2.2 Infiltration Testing

Infiltration testing was also performed as part of our field exploration near bore hole B-1 at a depth of about 5 feet below the existing ground surface. The testing consisted of drilling to the specified depth, filling the hollow stem of the drill auger with water, and measuring the rate of water level drop with time. The results of this test indicate that the near surface clay soils have an infiltration rate of approximately 1 hour per inch. This rate could increase (become slower) over time due to siltation, thus we recommend an appropriate factor of safety be applied for design.

3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Dry Density, ASTM D-2937, Dry unit weight representing field conditions
3. Atterberg Limits, ASTM D-4318, Plasticity and workability
4. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis
5. One Dimension Consolidation, ASTM D-2435, Consolidation properties
6. California Bearing Ratio, ASTM D-2937, Subgrade support properties

To provide data for an analysis of potential settlement from structural loading, a one-dimensional consolidation test was performed on each of 4 samples of the subsurface clay soils collected in the bore holes. Based upon data obtained from the consolidation testing, the clay soils at this site are moderately over-consolidated, moderately compressible under additional loading, and have swell potentials of approximately 1.5 to 1.9% at a load of 1,000 psf when water was added (see the **Lab Summary Table** below). Detailed results of the consolidation tests are maintained within our files and can be transmitted to you, if so desired.

Laboratory test results are presented on the bore hole logs (***Figures 2 through 7***) and in the **Lab Summary Table** on the following page:

LAB SUMMARY TABLE

BORE HOLE	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS			COLLAPSE (-)/ EXPANSION(+)
						GRAV.	SAND	FINES	LL	PL	PI	
B-1	2.5	CH	SPT	26				97	56	13	43	
B-1	5	CH	Shelby	19	108							
B-1	10	CH	Rings	25				98				
B-1	20	CL	Rings	25	97	0	20	80	30	21	9	+0.0%
B-1	25	SP-SM	SPT	13		22	73	5				
B-1	40	Claystone	SPT	13				93	50	14	36	
B-2	2.5	CH	Shelby	20	106							+1.9%
B-2	5	CH	SPT	27				96				
B-2	15	CH	Rings	24				93				
B-2	20	GP	SPT	8		55	42	3				
B-3	5	CH	Shelby	23	102			88	64	19	45	+1.5%
B-3	10	CH	Shelby	24	101			92				
B-3	20	CH	SPT	9		0	32	68				
B-3	30	SC	SPT	22		11	77	12				
B-4	0	CH	SPT	22				95				
B-4	2.5	CH	Shelby	22	104							
B-4	7.5	CH	Rings	27	96			95	57	14	43	+0.1%
B-4	20	SP-SM	Rings	26		0	95	5				
B-4	30	SP	SPT	22		0	96	4				
B-5	2.5	CH	Shelby	22	101			97				
B-6	5	CH	Shelby	24				94				

A sample of the near surface soil at B-3 was also tested for corrosion potential (pH, Sulfate, Resistivity). These results are discussed in **Sections 6.5** and **7.1.**

4.0 GEOLOGIC & SEISMIC CONDITIONS

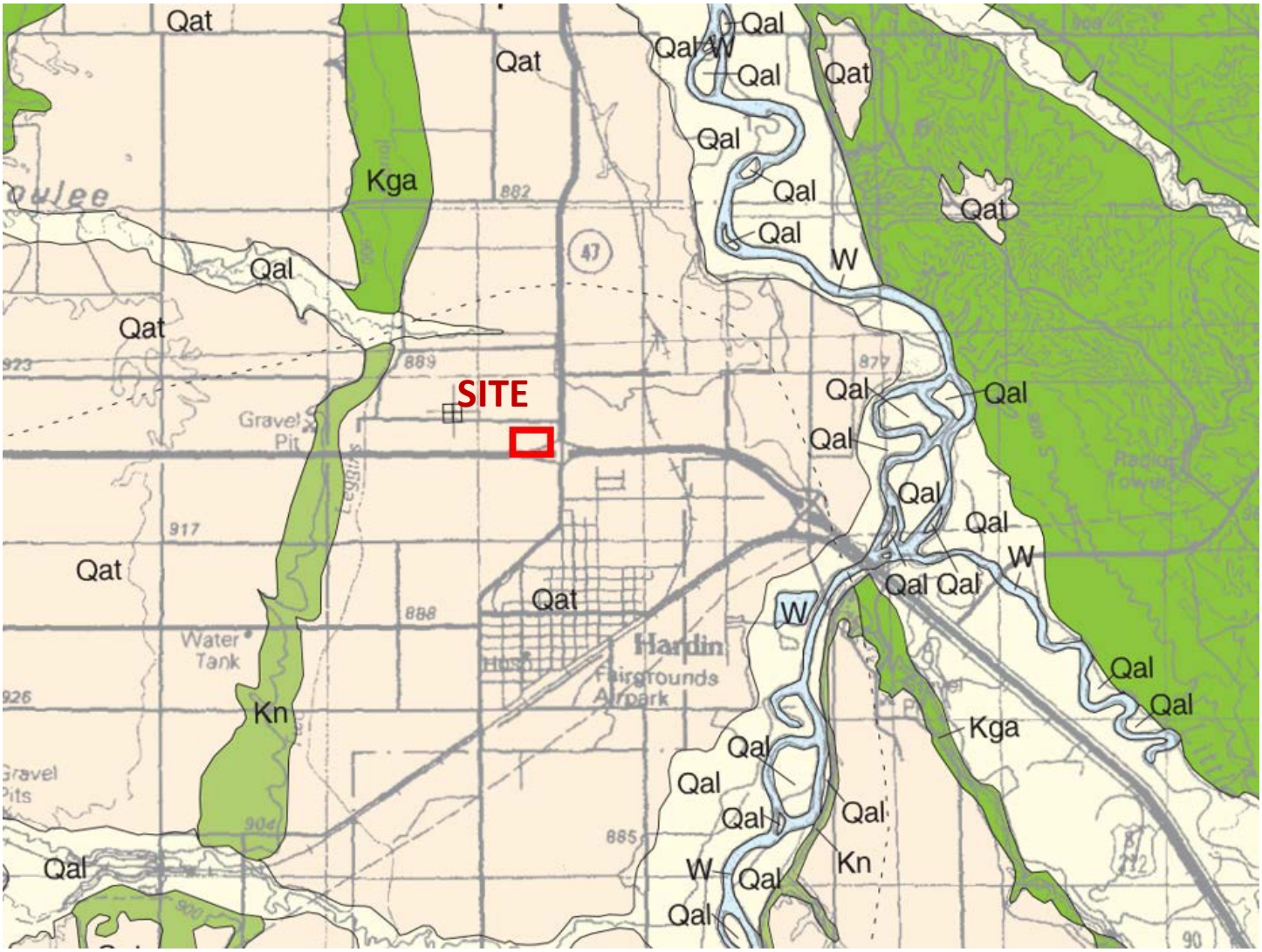
4.1 Geologic Setting

The subject site is in the Big Horn River Valley in southeast Montana. The Big Horn River is a north-south trending river that is part of the Missouri River Basin in the Great Plains Physiographic province. The site sits at an elevation of approximately 2,898 feet above sea level.

The geology of the Hardin 30' x 60' quadrangle has been mapped by Vuke and others[2]. The surficial geology at the location of the subject site and adjacent properties has been mapped as "Alluvial terrace deposit" (Map Unit Qat) dated as Pleistocene. Unit Qat is described as "Gravel, sand, silt, and clay underlying alluvial terrace surfaces adjacent to and higher in elevation than modern streams and rivers; poorly to moderately well

[2] Vuke SM, Wilde EM, Bergantino RN, 2007, *Geologic Map of the Hardin 30' x 60' Quadrangle, Montana*, Montana Bureau of Mines and Geology Open-File Report 585, 1:50,000 scale.

stratified and sorted with planar and trough cross-bedding. At least three distinct terrace levels in the map area along the Yellowstone River and its tributary, Fly Creek, range from 8 to 395 feet above the river and creek. Gravel composed of rounded to subrounded clasts of granitic igneous rocks, schist, gneiss, and quartzite, with fewer clasts of limestone and sandstone. Thickness ranges from 3 to 10 feet. At least eight distinct terrace levels are recognized along Big Horn River and Little Big Horn River, ranging from 15 to 560 feet above the rivers. Gravel composed of rounded to subrounded clasts of limestone and dolomite, andesite and other mafic volcanic rocks, quartzite, granitic rocks and sandstone and chert, in order of descending abundance. Lowest terrace deposit has been dated at about 0.02 Ma and highest at 1.2 Ma. Thickness of unit ranges from 15 to 50 feet." Refer to the **Geologic Map** shown below.



GEOLOGIC MAP

4.2 Faulting

No active surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. The nearest active (movement in the last 10,000 years) fault is the Mirror Plateau Fault 426 miles to the southwest. Seismic design issues are addressed in **Section 4.3** below.

4.3 Seismicity

4.3.1 Site Class

Montana has adopted the International Building Code (IBC) 2018 and recently adopted IBC 2021 (to go into effect on June 11, 2023), both of which determine the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). For site class definitions, IBC 2018 (and IBC 2021) Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class.

The blow counts obtained in bore hole B-1, which extended to the maximum depth explored of 40 feet, were below 15 in the upper 20 feet, but increased with depth, and bedrock was encountered in a couple of the bore holes. Based upon these conditions, it is our opinion the site best fits Site Class D – Stiff Soil Profile (with data), which we recommend for seismic structural design.

4.3.2 Ground Motions

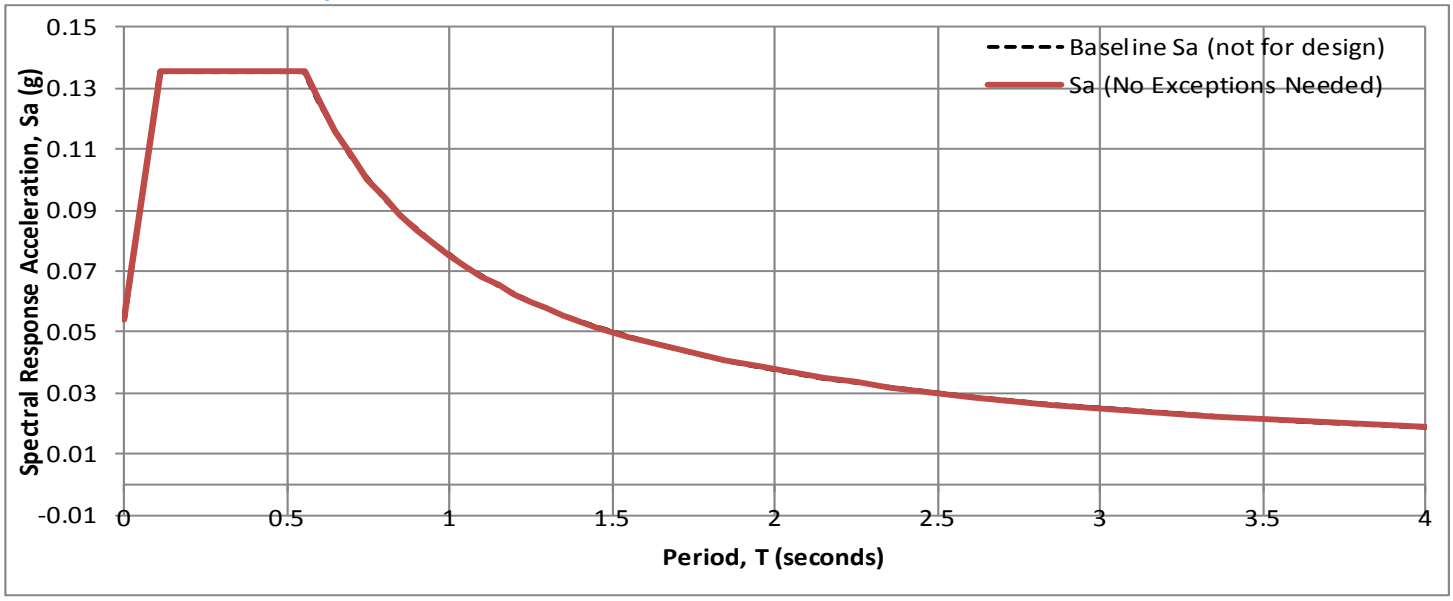
The 2014 USGS mapping utilized by the IBC provides values of peak ground, short period and long period spectral accelerations for the Site Class B/C boundary and the Risk-Targeted Maximum Considered Earthquake (MCE_R). This Site Class B/C boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The table and response spectra on the following page summarize the peak ground, short period and long period accelerations for the MCE_R event, and incorporates appropriate soil correction factors for a Site Class D (with data) soil profile at site grid coordinates of 45.7484 degrees north latitude and -107.6140 degrees west longitude:

SPECTRAL ACCELERATION PERIOD, T	SITE CLASS B/C BOUNDARY [mapped values] (g)	SITE COEFFICIENT	SITE CLASS D* [adjusted for site class effects] (g)	MULTI-PLIER	DESIGN VALUES (g)
Peak Ground Acceleration	PGA = **0.062**	F_{pga} = 1.600	PGA_M = 0.099	1.000	PGA_M = 0.099
0.2 Seconds (Long Period Acceleration)	S_S = **0.127**	F_a = 1.600	S_{MS} = 0.203	0.667	S_{DS} = 0.135
	(no exceptions needed)	F_a = (N/A)	S_{MS} = (N/A)	0.667	S_{DS} = (N/A)
1.0 Second (Long Period Acceleration)	S_1 = **0.047**	F_v = 2.400	S_{M1} = 0.113	0.667	S_{D1} = 0.075
	(no exceptions needed)	F_v = (N/A)	S_{M1} = (N/A)	0.667	S_{D1} = (N/A)

NOTES: 1. TL (seconds): **8** *** Site Class D With Data**

2. Site Class: **D** **4. No Exceptions Needed**

3. Have data to verify? **yes**



4.3.3 Liquefaction

Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Subsurface soils encountered consisted predominately of high plasticity clay, considered not liquefiable. However, layers of saturated sand and gravel, some of which were in a loose state, were encountered below the clay.

We evaluated the liquefaction potential of the sand and gravel layers using the procedures described in Youd et al[3] and Idriss & Boulanger[4]. Our evaluation indicates that due to the low seismicity of the area these layers will not liquefy. In the absence of liquefaction, lateral spreading will not occur.

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a currently known or mapped potential debris flow, stream flooding, or rock fall hazard area.

5.0 SITE CONDITIONS

5.1 Surface Conditions

The site is currently an agricultural field. Based upon aerial photos dating back to 1996 that are readily available on the internet, the site has remained relatively unchanged. Overall, the site is relatively flat, with a very slight slope downward to the east. The site is bordered on the north by Dorn Road, on the east by Highway 47, on the south by the west bound on-ramp to Interstate 90, and on the west by agricultural fields (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the bore holes, we encountered approximately 12 to 18 inches of topsoil at the surface. Immediately below the topsoil we encountered moist to wet, brown to gray-brown, Fat CLAY (CH) and Lean CLAY (CL) extending to the bottom of bore holes B-5 and B-6 at approximately 16.5 feet below the surface, and to depths of between 19 and 30 feet below the surface in the other bore holes. These clay soils appear to be soft to hard in consistency based upon the SPT blow counts. Consolidation testing of samples of these soils indicates they have a potential to swell when wetted with swell pressures of approximately 4,500 psf.

Just below the clay in B-4 a thin layer of brown SILT (ML), approximately 1.5 feet in thickness was encountered. Below the silt in B-4, and below the clay in B-1, B-2, and B-3 we encountered layers of gray to dark gray, wet, Poorly Graded SAND with varying amounts of silt (SP, SP-SM) and brown to gray-brown Poorly Graded GRAVEL (GP) with sand, which extended to the bottom of bore holes B-2 and B-4 at approximately 30.0 and 31.5 feet below the existing ground surface, respectively. The sand and gravel soils were in a loose to very dense state based upon the SPT blow counts. Claystone bedrock was encountered at about 39 feet in B-1, and at about 30 feet in B-2, which limited exploration depth.

[3]Youd, T.L.; Idriss, I.M.; Andrus, R.D.; Arango, I.; Castro, G.; Christian, J.T.; Dobry, R.; Finn, W.D.L.; Harder, L.F. Jr.; Hynes, M.E.; Ishihara, K.; Koester, J.P.; Liao, S.C.; Marcuson, W.F. III; Martin, G.R.; Mitchell, J.K.; Moriwaki, Y.; Power, M.S.; Robertson, P.K.; Seed, R.B.; and Stokoe, K.H. II; October 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," ASCE Journal of Geotechnical and Geoenvironmental Engineering, p 817-833.

[4]Idriss, I.M. and Boulanger, R.W., December 2010, "SPT-Based Liquefaction Triggering Procedures," Department of Civil & Environmental Engineering, University of California at Davis, Report No. UCD/CGM 10/02, 259 p.

For a more descriptive interpretation of subsurface conditions, please refer to the bore hole logs, ***Figures 2 through 7***, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries; in situ, the transition between soil types may be gradual.

5.3 Groundwater

Groundwater was encountered in the bore holes at depths of about 12 to 14 feet below existing grade at the time of our field exploration, thus groundwater is likely to be encountered in the tank pit excavation.

Groundwater levels can fluctuate seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, and the magnitude of potential fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes vegetation, topsoil, loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the bore holes there is topsoil and/or soils loosened/disturbed by cultivation on the surface of the site which we estimated to be up to about 1.5 feet in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 4 inches.

Following stripping and grubbing the subgrade should be observed by a CMT geotechnical engineer to assess that suitable natural soils have been exposed and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 3 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations deeper than 16 feet are not anticipated at the site. Groundwater was encountered at about 12 to 14 feet below the surface at the time of our field explorations, and thus is anticipated to be encountered in the tank excavation.

It is the contractor's responsibility to provide safe working conditions and comply with the regulations in OSHA Standards-Excavations, 29 CFR Part 1926. The following guidelines are provided for planning purposes. Sloping and shoring requirements must be evaluated at the time of construction by the contractor's competent person as defined by OSHA. The geotechnical engineer is NOT the contractor's "competent person" in any circumstance, including but not limited to, by way of default or delegation. OSHA classifications for various material types and the steepest allowable slope configuration corresponding to those classifications are shown in following table.

ALLOWABLE SLOPE CONFIGURATION FOR ONSITE MATERIAL

MATERIAL TYPE	OSHA CLASSIFICATION	STEEPEST ALLOWABLE SLOPE CONFIGURATION*
Native Clay	Type B	1:1
Native Sand	Type C	1-1/2:1

* Units horizontal to units vertical. The values shown apply to excavation less than 20 feet in height. Conditions can change and evaluation is the contractor's responsibility.

The preceding classifications and slope configurations assume that excavations are above the groundwater table, there is no standing water in the excavations, and there is no seepage from the slope into the excavations, unless otherwise specified. The preceding classifications and slope configurations assume that the material in the excavations is not fractured, adversely bedded, jointed, nor left open to desiccate, crack, or slough, and is protected from surface runoff. There are other considerations regarding allowable slope configurations that the contractor is responsible for, including proximity of equipment, stockpiles, and other surcharge loads to the excavation. The contractor's competent person is responsible for all decisions regarding slope configuration and safety conditions for excavations.

Excavations should not undermine existing foundation systems of structures or infrastructure unless they are adequately protected. At a minimum, new excavations should not intersect a line drawn on a 45-degree angle down and away from the bottom edge of the existing foundation systems or bottom edge of infrastructure. If this condition cannot be met, shoring or staged excavations may be required. If shoring is required, a condition survey of the adjacent structures is recommended before construction starts and upon completion of construction. In CMT's experience, condition surveys include, but may not be limited to photographs of any distress to adjacent structures.

Permanent slopes should be no steeper than 3H:1V and revegetated or otherwise protected from erosion.

6.3 Fill Material

Where fill/backfill soil is necessary, imported material is recommended. Recommendations for fill/backfill placement are:

a) Clods, lumps, or claystone shall be broken down to a maximum size of 3 inches. Pieces larger than 3 inches shall be removed from the fill/backfill.
b) Fill/backfill material should be placed in loose lifts and compacted in accordance with the table in **Section 6.4**.
c) Maximum loose lift thickness shall be 6 inches, depending on the type of equipment used to apply compactive effort and shall be reduced if the specified compaction cannot be obtained with the equipment used.
d) Fill/backfill should not be placed if material is frozen or if the placement surface is frozen.
e) Fill/backfill material should be placed and spread in horizontal lifts of uniform thickness in a manner that avoids segregation.
f) Placement surface should be kept free of standing water, debris, and unsuitable material during placement and compaction of fill/backfill material.
g) Fill/backfill maximum allowable particle size is 3 inches. Do not incorporate oversize material in the fill/backfill that is incapable of being broken down by the equipment and methods being employed to process and compact the fill/backfill. Process and compact material in the lift, as necessary, to produce the specified fill/backfill characteristics. If oversize particles remain in the lift after processing and compacting, remove oversize material to produce a fill/backfill within specified requirements.
h) Overlot fill placement and compaction should be observed and tested on a full-time basis by a representative of CMT. At a minimum, utility trench backfill and pavement subgrade should be tested in accordance with jurisdictional requirements.

Material imported for structural fill should be tested and approved for use onsite by the project geotechnical engineer prior to hauling to the site. Proctor, remolded swell, and classification tests should be conducted to determine if the fill meets required specifications. Fill materials should be well graded, low permeable material meeting the specifications in the table below.

IMPORT FILL SPECIFICATIONS

SOIL PARAMETER	SPECIFICATION
Maximum particle size	1 inch
Percent finer than No. 200 sieve	20% to 40%
Liquid limit	20% to 40%
Plasticity index	8% to 15%
Swell potential under anticipated loads	less than 1%*

* Upon inundation, when remolded to 97% maximum dry density at 1% below the optimum moisture content per ASTM D698 at a surcharge pressure of 100 psf.

All fill material should be approved by a CMT geotechnical engineer prior to placement.

6.4 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most "trench compactors" have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D698- in accordance with the following recommendations:

FILL LOCATION	MATERIAL TYPE (GENERAL)	AASHTO CLASSIFICATION	MATERIAL THICKNESS (FT)	MOISTURE CONTENT (%)	RELATIVE COMPACTION (%)	COMPACTION STANDARD
Structural fill (includes all overlot grading)	Granular material that is clean to silty	A-1, A-2-4, A-2-5, A-3, A-4, A-5	≤15	±2% of OMC	≥95%	Standard Proctor (ASTM D698)
	Fine grained material and granular material with plastic fines	A-2-6, A-2-7 A-6, A-7		0% to +3% of OMC		
Top 12 inches of subgrade below pavement	All	All	≤1X (from municipality requirements)	0% to +3% of OMC	≥95%	Standard Proctor (ASTM D698)
ABC	Granular material	Per Denver or CDOT requirements	From pavement design)	±2% of OMC	≥95%	Modified Proctor (ASTM D1557)

6.5 Utility Trenches

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA[5] requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section. Above the bedding zone, we recommend that utility trench backfill have a minimum 20% fines, to reduce permeability (refer to **Section 6.3** above) due to the expansive soils.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the

[5] American Public Works Association

backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557).

Where the utility does not underlie structurally loaded facilities and public rights of way, natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**.

Chemical testing results on a sample of the near surface clay soil from B-3 indicates a resistivity less than the reporting limit of 1 ohm-m. This is considered a highly corrosive environment for metal. The corrosive potential can be reduced utilizing cathodic protection or polyethylene coating.

6.6 Stabilization

The natural clay soils at this site will be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the surface by using lighter equipment and/or partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils.

If rutting or pumping occurs, traffic should be stopped, and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles nd/or 1.5- to 2.0-inch clean gravel should be utilized. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i, or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, the subsurface conditions observed in the field and the laboratory test data, as well as common geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the subsurface natural clay soils within the upper 5 to 7.5 feet below the existing site grade have a potential to swell/heave when wetted. The potential for heave can be reduced, but not eliminated. The most common approach is to remove the expansive soil to a recommended

depth below slabs and foundations (i.e., over excavate or sub-excavate) and either replace the excavated expansive soil with non-expansive material or moisture condition the excavated soil to reduce the swell potential and replace it as compacted, moisture conditioned fill in the excavation. However, given the high plasticity of the natural clay soils, it would likely prove very difficult to control the moisture content to achieve proper compaction of the natural clay soils. Other methods to reduce swell potential are also available (such as amendment with lime) and CMT can provide more information about such methods, upon request.

To reduce the potential for footing and slab movement, CMT recommends over-excavating and replacement of the existing soil to 5 feet below bottom of footing elevation with imported, non-expansive fill as specified in **Section 6.3 Fill Material**. This will extend footing support through the potentially expansive zone and will reduce the risk of movement but will not eliminate it. The replacement fill should be placed as discussed in **Section 6.4 Fill Placement and Compaction.** The over-excavation and replacement should extend laterally at least 5 feet beyond the exterior footings and counterforts/building lines.

CMT recommends that footings be designed for maximum allowable bearing pressure of 2,500 psf. We also recommend the following:

1. Exterior footings subject to frost should be placed at least 36 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.

Soluble sulfate test results on a sample of the near surface clay soil from B-3 indicates sulfate content of 3,370 mg/kg. This is considered an ACI Class S2 exposure and the appropriate guidelines should be followed. The resistivity testing indicates a highly corrosive environment for buried metal. Proper cover should be maintained for all reinforcement bar, or coated bar should be considered.

7.2 Installation

Under no circumstances shall foundations be placed directly on potentially swelling soils, on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. The base of footing excavations should be observed by a CMT geotechnical engineer to confirm that suitable bearing soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

7.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some movement, potentially from soils with swell potential that may extend deeper than our testing has indicated, or from settlement due to structural loads. We anticipate that total settlement of footings founded as recommended above will not exceed 1 inch, with differential movements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

8.0 LATERAL EARTH PRESSURES

We anticipate that below-grade walls up to 4 feet high might be constructed at this site. The lateral earth pressure values given below are for a backfill material that will consist of drained sand/gravel soils (less than 10% passing No. 200 sieve) placed and compacted in accordance with the recommendations presented herein. If other soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf/ft)**
Active Pressure (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where "H" is the total height of the wall)	35	4
At-Rest Pressure (wall is not allowed to yield)	55	N/A
Passive Pressure (wall moves into the soil)	425	30

*Equivalent Fluid Pressure (applied at 1/3 Height of Wall)

**Equivalent Fluid Pressure (added to static and applied at 1/3 Height of Wall)

9.0 FLOOR SLABS

Floor slabs may be established upon the imported structural fill (same as for foundations). Under no circumstances shall floor slabs be established directly on potentially expansive natural clay soils, or any topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

To facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs may have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

10.0 EXTERIOR CONCRETE FLATWORK

Exterior flatwork is susceptible to movement resulting from on-site moisture sensitive soils. Flatwork supported on foundation wall backfill may settle and crack if the backfill is not properly moisture conditioned and compacted.

To reduce potential movement of exterior flatwork, CMT recommends removing, moisture conditioning, and replacing the upper 2 feet of expansive/moisture sensitive soil beneath the exterior flatwork**.** Over excavating and moisture conditioning will reduce swell/heave potential, create a relatively impervious surface over the more expansive/moisture sensitive material, and retard wetting of the deeper unconditioned expansive/moisture sensitive material. This conditioning will reduce potential exterior slab-on-grade movement but will not eliminate it. Moisture conditioning and re-compaction of the natural soils may be difficult, and over excavation and replacement with structural fill may be more practical.

Exterior flatwork should be isolated from the structures. Exterior flatwork should be expected to move, although measures can be incorporated into construction to limit the movement or effects of the movement. CMT recommends flatwork not be doweled into foundations, but rather supported on a haunch to limit settlement. The haunch should extend the full length of the slab.

Exterior flatwork, such as driveways and sidewalks, are normally constructed as slabs-on-grade. Porches and patios are increasingly constructed as structurally supported slabs, which in CMT's opinion, is the most positive means of keeping slabs from moving and adversely affecting the operation of doors or means of egress. CMT recommends that landings and slabs at egress doors, as well as porches and patios, be constructed as structurally supported elements if potential movement cannot be tolerated.

CMT recommends use of connections or other details between foundations and deck posts, so the posts can be trimmed or adjusted if movement occurs.

11.0 DRAINAGE RECOMMENDATIONS

Good drainage and surface water management is important. Performance of site improvements, such as foundations, floors, hardscape, and pavement are often adversely affected by failing to establish and/or maintain good site drainage. Grades must be adjusted to provide positive drainage away from the structure, pavement, and other site improvements during construction and maintained throughout the life of the proposed facility. The following drainage precautions are recommended:

1. Ground surface around the perimeter foundation walls should be sloped to drain away from the structure in all directions. Current building codes require a minimum slope of 6 inches in the first 10 feet (5%) of the structure. At the completion of construction, CMT recommends a continuous slope away from foundations of 12 inches in the first 10 feet (10%), where site constraints permit. CMT recommends that concrete and pavement adjacent to structures slope at a rate of at least 2% away from the structure or as otherwise required by ADA criteria. Maximum grades as practical should be used for paving and flatwork to prevent areas where water can pond.
2. Joints that occur at locations where paving or flatwork abuts the structure should be properly sealed with flexible sealants and maintained.
3. Ground surface should be sloped so water will not pond between or adjacent to structures and other site improvements. Curbs, sidewalks, paths, plants, or other improvements should not block, impede, or otherwise disrupt surface runoff. Use of chases and weep holes to promote drainage is encouraged. Landscape edging should be perforated or otherwise constructed in a manner to prevent ponding of surface water, especially in the vicinity of the backfill soil.
4. Drainage swales should be located as far away from the foundation as practicable.
5. If site constraints do not allow for the recommended slopes, the project civil engineer shall provide a method for drainage that is equivalent to the recommendations herein. Water should not be allowed to pond adjacent to or near foundations, flatwork, or other improvements.
6. Roof downspouts and other water collection systems should discharge onto pavements or extend away from the structure well beyond the limits of the backfill zone using downspout extensions, appropriately sized splash blocks, or other means. Buried downspout extensions are discouraged as they can be difficult to monitor and maintain.
7. Irrigation directly adjacent to the structure is discouraged and should be minimized. Sprinkler lines, zone control boxes, and sprinkler drains shall be located outside the limits of the foundation backfill. Sprinkler systems should be placed so that the spray from the heads, under full pressure, does not fall within 5 feet of the foundation walls.
8. Plants, vegetation, and trees that require moderate to high water usage are discouraged and should not be located within 5 feet of foundation walls.
9. Plantings within 10 feet of the foundation should be placed in watertight planters/containers.

The project civil engineer shall perform measurements to document that positive drainage, as described in this section or as otherwise designed by the project civil engineer is achieved. Maintenance of surface drainage is imperative subsequent to construction and is the responsibility of the owner and/or tenant.

11.0 PAVEMENTS

At least the top 12 inches of the subgrade should be removed and replaced with imported structural fill. Under no circumstances shall pavements be established over topsoil, unprepared undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In roadway areas, subsequent to stripping and surface preparation, and prior to the placement of pavement materials, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted

construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered, we recommend they be removed to a minimum of 18 inches below the subgrade level and replaced with structural fill.

To provide data to aid in pavement design a California Bearing Ratio (CBR) test was performed on a bulk sample of the near surface from the site. Results are presented in the following table:

SAMPLE TYPE	SOIL CLASS	OPTIMUM MOISTURE(%)	MAX DRY DENSITY (pcf)	CBR (%)
Bulk	CH	15.3	108.7	3

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the given ESAL's (18-kip equivalent single-axle loads) per day:

PAVEMENT DESIGN TABLE

MATERIAL	PAVEMENT SECTION THICKNESS (inches)					
	PARKING AREAS (Moderate Duty) (4 ESAL'S per day)		HI-FLOW/TRUCK LANES (Heavy Duty) (378 ESAL'S per day)			
Asphalt	**4***	**---**	**6***	**6***	**6***	**---**
Concrete	**---**	**6***	**---**	**---**	**---**	**8***
Road-Base	**10**	**5***	**10†**	**8***	**10†**	**8**
Subbase	**0**	**0**	**16**	**12‡**	**5‡**	**0**
Total Thickness	**14**	**11**	**32**	**26**	**21**	**16**

*Maverik Minimum
†Over Tensar NX750 Geogrid, or equivalent
‡Over Tensar NX750 Geogrid, or equivalent, and non-woven separation fabric
The recommended 12 inches of structural fill in pavement areas may be included in the sub base thicknesses recommended above

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus DOT specifications for A–1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, or to local requirements, whichever is more stringent.

The rigid pavement sections recommended above are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 3,000 pounds per square inch and contain 6% ±1% air-entrainment.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete and 6 inches of aggregate base over properly prepared suitable natural subgrade or site grading structural fills extending to suitable natural soils. Dumpster pads constructed overlying undocumented fills must be heavily reinforced.

12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT onsite we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or his representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

13.0 LIMITATIONS

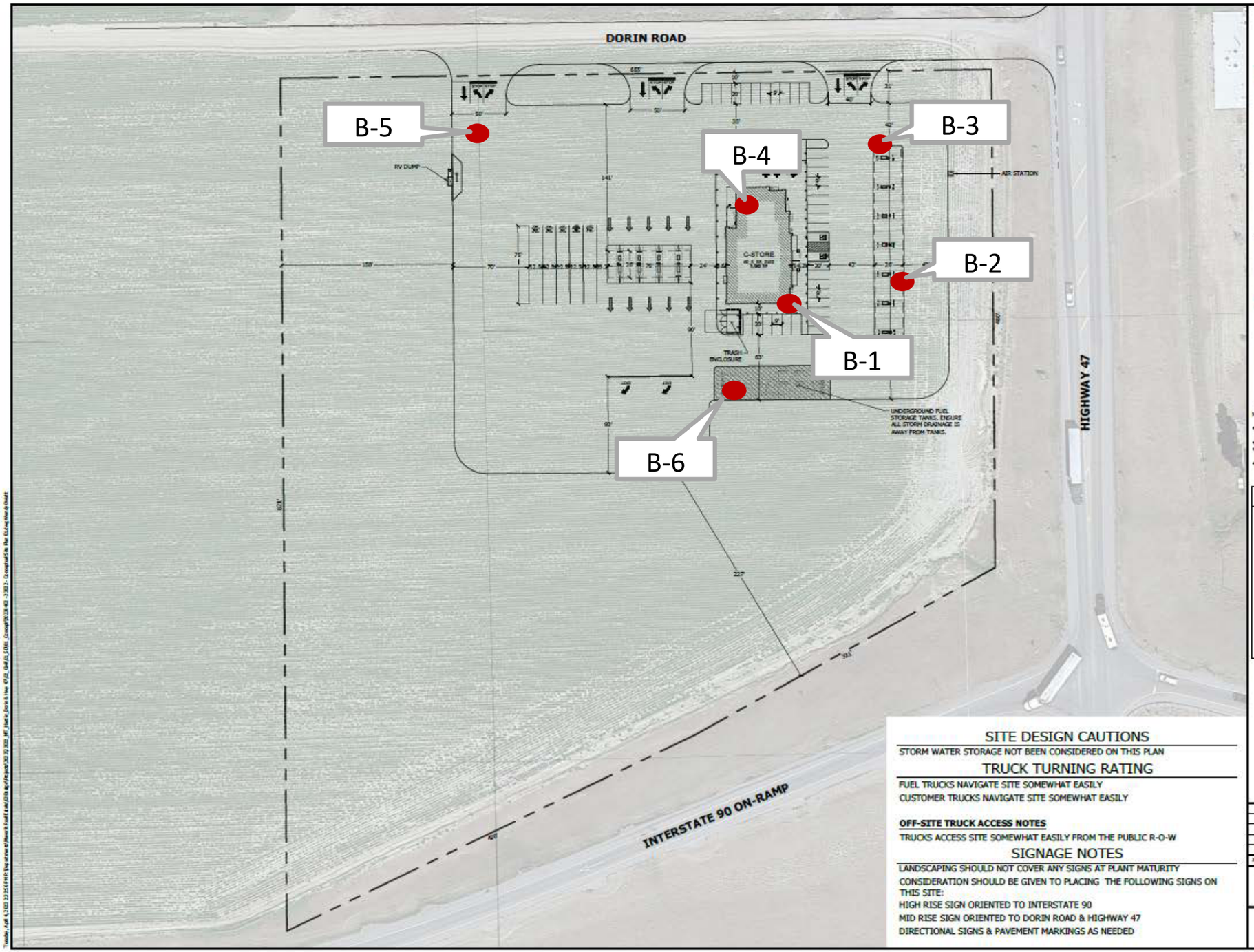
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING
DOCUMENTATION



MAVERIK

STORE #: TBD
MAVERIK, INC.
DORIN ROAD &
HIGHWAY 47
HARDIN, MONTANA



NOTES:

- AREAS AND DIMENSIONS PROVIDED ARE APPROXIMATE AND SHOULD BE VERIFIED BY A SURVEY.
- THIS PLAN IS FOR ILLUSTRATIVE PURPOSES ONLY.
- THE BOUNDARIES OF THE PROPERTY SHOWN ON THIS DRAWING WERE CREATED FROM SCALED INFORMATION AND SHOULD NOT BE CONSIDERED ACCURATE.
- THIS IS A SCHEMATIC DRAWING AND ENGINEERS SHOULD TAKE CARE TO CREATE ACCURATE GEOMETRY FOLLOWING MAVERIK STANDARDS.

SITE DATA

PARKING:	42 STALLS PROVIDED (2 A.D.A.) (Not incl. gas canopy locations)	
PARCEL AREA:	430,347 SQ. FT.	9.88 ACRES
BUILDING AREA:	5,982 SQ. FT.	0.14 ACRES

N

40 0 40 80 120
Scale: 1" = 40'

#	DATE	DESCRIPTION	REVISED BY
1	2023/04/04	CONCEPTUAL SITE PLAN 01	

JOB NUMBER 23-022 DRAWN BY WG

CONCEPTUAL SITE PLAN 01

Option A

SITE DESIGN CAUTIONS

STORM WATER STORAGE NOT BEEN CONSIDERED ON THIS PLAN

TRUCK TURNING RATING

FUEL TRUCKS NAVIGATE SITE SOMEWHAT EASILY
CUSTOMER TRUCKS NAVIGATE SITE SOMEWHAT EASILY

OFF-SITE TRUCK ACCESS NOTES

TRUCKS ACCESS SITE SOMEWHAT EASILY FROM THE PUBLIC R-O-W

SIGNAGE NOTES

LANDSCAPING SHOULD NOT COVER ANY SIGNS AT PLANT MATURITY
CONSIDERATION SHOULD BE GIVEN TO PLACING THE FOLLOWING SIGNS ON THIS SITE:
HIGH RISE SIGN ORIENTED TO INTERSTATE 90
MID RISE SIGN ORIENTED TO DORIN ROAD & HIGHWAY 47
DIRECTIONAL SIGNS & PAVEMENT MARKINGS AS NEEDED

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-1

Total Depth: 41.5
Water Depth: 14
Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		Brown to Gray-Brown Fat CLAY (CH), moist to very moist												
		soft		1	1 1 2	3								
		medium stiff		2	3 2 2	4	26				97	56	13	43
4				3			19	108						
8				4	0 2 3	5								
				5	2 4 6	10	25				98			
12														
		wet		6	1 3 3	6								
16														
20		Gray Brown Lean CLAY (CL), wet												
		stiff		7	3 6 12	18	25	97	0	20	80	30	21	9
		Gray to Dark Gray Poorly Graded SAND with silt (SP-SM) and gravel, wet												
24		medium dense		8	6 8 8	16	13		22	73	5			
28		Gray Poorly Graded GRAVEL (GP) with sand, wet												

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.79824°, -107.613657°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 2

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-1

Total Depth: 41.5□
Water Depth: 14□
Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
28		Gray Poorly Graded GRAVEL (GP) with sand, wet												
		medium dense		9	10 19 6	25								
32														
		Blue-Gray Lean CLAY (CL), wet												
36														
		Gray-Brown Claystone Bedrock												
40		hard		10	12 27 50/4"		13				93	50	14	36
		REFUSAL AT 41.5□												
44														
48														
52														
56														

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.79824°, -107.613657°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell
Page: 2 of 2

CMT TECHNICAL SERVICES

Figure: 2

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-2

Total Depth: 30
Water Depth: 14

Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description		Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		Gray-Brown Fat CLAY (CH), moist	soft to medium stiff		11	2 2 2	4								
					12			20	106						
4			soft		13	0 1 2	3	27				96			
					14										
8			medium stiff		15	0 2 3	5								
12			wet		16	4 6 8	14	24				93			
16															
20		Gray-Brown Poorly Graded GRAVEL (GP) with sand, wet	dense		17	22 18 12	30	8		55	42	3			
24		no sample due to heaving sands													
28															

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.748596°, -107.612946°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 3

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-2

Total Depth: 30
Water Depth: 14
Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N) Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
28		Gray-Brown Poorly Graded GRAVEL (GP) with sand, wet											
		REFUSAL AT 30.0											
32													
36													
40													
44													
48													
52													
56													

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.748596°, -107.612946°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell
Page: 2 of 2

CMT TECHNICAL SERVICES

Figure: 3

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-3

Total Depth: 31.5
Water Depth: 13

Date: 5/2/23
Job #: 20087

Depth (ft)	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0	Gray -Brown Fat CLAY (CH), moist to very moist — stiff		18	2 2 6	8								
	medium stiff		19	2 2 3	5								
4			20			23	102			88	64	19	45
			21	1 2 3	5								
8			22			24	101			92			
12 ▽	wet		23	3 3 3	6								
16													
20	grades sandy — hard		24	15 18 17	35	9		0	32	68			
24			25	5 13 14	27								
28													

Remarks: Groundwater encountered during drilling at depth of 13 feet.

Coordinates: 45.79893°, -107.6136°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 4

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-3

Total Depth: 31.5□
Water Depth: 13□
Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Sand %	Fines %	Atterberg LL	PL	PI
28		Gray -Brown Fat CLAY (CH), wet												
		Gray-Brown Clayey SAND (SC) with gravel, wet dense		26	7 15 18	33	22		11	77	12			
32		END AT 31.5□												
36														
40														
44														
48														
52														
56														

Remarks: Groundwater encountered during drilling at depth of 13 feet.

Coordinates: 45.79893°, -107.6136°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 4

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-4

Total Depth: 31.5
Water Depth: 14

Date: 5/2/23
Job #: 20087

Depth (ft)	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0	Gray Brown Fat CLAY (CH), moist to very moist soft to medium stiff		27	1 1 3	4	22				95			
			28			22	104						
4	soft		29	0 1 2	3								
8			30	2 3 6	9	27	96			95	57	14	43
	medium stiff		31	1 3 2	5								
12													
	wet		32										
16													
20	Brown SILT (ML) with fine sand, wet												
	Gray Poorly Graded SAND with silt (SP-SM), wet medium dense		33	4 6 9	15	26		0	95	5			
24	very dense		34	15 41 19	60								
28	Brown to Gray Poorly Graded GRAVEL (GP) with sand, wet												

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.7486°, -107.61393°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 5

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-4

Total Depth: 31.5□
Water Depth: 14□

Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
28		Brown to Gray Poorly Graded GRAVEL (GP) with sand, wet												
		Gray Poorly Graded SAND (SP), wet loose		35	3 2 2	4	22		0	96	4			
32		END AT 31.5□												
36														
40														
44														
48														
52														
56														

Remarks: Groundwater encountered during drilling at depth of 14 feet.

Coordinates: 45.7486°, -107.61393°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure: 5

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-5

Total Depth: 16.5□
Water Depth: 12□

Date: 5/2/23
Job #: 20087

Depth (ft)	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0	Gray Brown Fat CLAY (CH), moist to very moist												
	medium stiff		36	2 2 3	5								
			37			22	101			97			
4			38	2 3 2	5								
	soft		39	1 1 2	3								
8			40										
12 ▽	wet												
	stiff		41	4 4 6	10								
16	END AT 16.5□												
20													
24													
28													

Remarks: Groundwater encountered during drilling at depth of 12 feet.

Coordinates: 45.74579°, -107.6145°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell
Page: 1 of 1

CMT TECHNICAL SERVICES

Figure: 6

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Bore Hole Log B-6

Total Depth: 16.5□
Water Depth: 12□

Date: 5/2/23
Job #: 20087

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		Gray Brown Fat CLAY (CH), moist to very moist medium stiff		42	2 2 3	5								
				43	2 2 3	5								
4				44			24				94			
				45	0 2 3	5								
8				46	1 3 4	7								
12		wet		47										
16		END AT 16.5□												
20														
24														
28														

Remarks: Groundwater encountered during drilling at depth of 12 feet.

Coordinates: 45.74805°, -107.61424°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Sterling Howell
Page: 1 of 1

CMT TECHNICAL SERVICES

Figure: 7

Maverik Store

SWC of Dorn Rd & Hwy 47, Hardin, MT

Key to Symbols

Date: 5/2/23

Job #: 20087

① Depth (ft)	② GRAPHIC LOG	③ Soil Description	④ Sample Type	⑤ Sample #	Blows(N) ⑥	Blows(N) ⑦ Total	⑧ Moisture (%)	⑨ Dry Density(pcf)	Gradation ⑩ Gravel %	Gradation ⑩ Sand %	Gradation ⑩ Fines %	Atterberg ⑪ LL	Atterberg ⑪ PL	Atterberg ⑪ PI

COLUMN DESCRIPTIONS

① **Depth (ft.):** Depth (feet) below the ground surface (including groundwater depth - see below right).

② **Graphic Log:** Graphic depicting type of soil encountered (see ② below).

③ **Soil Description:** Description of soils, including Unified Soil Classification Symbol (see below).

④ **Sample Type:** Type of soil sample collected; sampler symbols are explained below-right.

⑤ **Sample #:** Consecutive numbering of soil samples collected during field exploration.

⑥ **Blows:** Number of blows to advance sampler in 6" increments, using a 140-lb hammer with 30" drop.

⑦ **Total Blows:** Number of blows to advance sampler the 2nd and 3rd 6" increments.

⑧ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight).

⑨ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).

⑩ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), from lab test results of soil passing No. 4 and No. 200 sieves.

⑪ **Atterberg:** Individual descriptions of Atterberg Tests are as follows:

LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.

PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior.

PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

STRATIFICATION	
Description	**Thickness**
Seam	Up to ½ inch
Lense	Up to 12 inches
Layer	Greater than 12 in.
Occasional	1 or less per foot
Frequent	More than 1 per foot

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

MOISTURE CONTENT
Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp / moist to the touch, but no visible water.
Saturated: Visible water, usually soil below groundwater.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	②	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS The coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (< 5% 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 (≥ 12% fines)	GM		Silty Gravels, Gravel-Sand-Silt Mixtures
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS The coarse fraction passing through No. 4 sieve.	CLEAN SANDS (< 5% fines)	SW		Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP		Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (≥ 12% fines)	SM		Silty Sands, Sand-Silt Mixtures
			SC		Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		ML		Inorganic Silts and Very Fine Sands, Silty or Clayey Fine Sands or Clayey Silts with Slight
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
			OL		Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH		Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils with Plasticity (Elastic Silts)
			CH		Inorganic Clays of High Plasticity, Fat Clays
			OH		Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT		Peat, Humus, Swamp Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

SAMPLER SYMBOLS

- Block Sample
- Bulk/Bag Sample
- Modified California Sampler 3.5" OD, 2.42" ID
- D&M Sampler
- Rock Core
- Standard Penetration Split Spoon Sampler
- Thin Wall (Shelby Tube)

WATER SYMBOL

- Encountered Water Level
- Measured Water Level

(see Remarks on Logs)

1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
3. The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

CMT TECHNICAL SERVICES

Figure: 8

SECTION 01 0000 – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general requirements that are to apply to all Work throughout the Project. Requirements included in this Section are to apply to all other specification Sections.

1.3 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect s action on Contractor s submittals, applications, and requests, "approved" is limited to Architect s duties and responsibilities as stated in the Conditions of the Contract.

C. “Center of...”: Indicates a specific single point at the exact center of the tile, panel, or other surface indicated.

D. Conforms”: When used to convey Architect's action on Contractor s submittals, applications, and requests, “conforms” is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

E. “Contractor”: The General Contractor unless otherwise stated.

F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

H. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

I. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

J. “Project Manager”: The Contractor’s project manager.

K. “Project Representative”: The Owner’s project representative(s).

L. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

M. "Provide": Furnish and install, complete and ready for the intended use.

N. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

O. “Related Sections”: Related Sections articles are included herein as a courtesy to assist in the locating of items in the specifications that the reader might expect to find in the Section but that are specified elsewhere. The list of sections may or may not be complete. ‘Related Sections’ articles do not relieve the Contractor of the contractual obligation to perform to all the Contract Documents or to coordinate who does what amongst the team of subcontractors.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.5 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

1.6 SITE INSPECTION

A. Examine the premises and site and compare them with the drawings and specifications.

B. Become familiar with existing conditions such as obstructive areas, excavating or filling, and any problems related to construction. No allowances will subsequently be made by reason of failure to examine the site.

1.7 SCOPE OF THE WORK

A. See Section 01 1000 “Summary” for an overall general summary of the Work.

B. Unless otherwise provided, all materials, labor, equipment, tools, transportation, and utilities necessary for the successful completion of the Project shall be provided at the expense of the Contractor.

C. Requirements of the Work are contained in the Contract Documents, and include cross- references herein to published information, which is not necessarily bound therewith.

D. Provide, as part of the Bid and without additional charge, all incidental items required for completion of the Work, even if not specifically indicated.

1. Install all Work so that its several component parts function together as a complete and workable system, and with all equipment properly adjusted and in working order.

E. Conform to highest quality standards for materials and workmanship to execute Work that is indicated or specified and that is necessary to fully satisfy the Contract Document requirements for a complete, finished, acceptable installation regardless of whether indicated or specified or not.

F. Responsibilities of the Contractor includes the responsibility to verify all field measurements of actual building conditions so that all Work fits properly in the locations indicated and specified. Protect existing structures, improvements, trees, and other items from physical damage, unless identified to be removed.

G. Any existing surfaces, furniture or equipment that are damaged by the Contractor are to be restored to their original condition, or better, to the satisfaction of the Owner.

H. Restore roads, utilities, walks, curbs, gutters or other improvements belonging to the Owner, to the same condition as they existed prior to commencement of construction. Where said improvements are damaged, they shall be replaced by new Work to match existing adjacent Work, or repaired if acceptable to Project Representative, at no cost to Owner.

1.8 WORKERS

A. Enforce strict discipline and good order among his/her employees at all times and shall not employ on the Project any unfit person or anyone not skilled in the Work assigned to him/her.

B. Consumption of alcohol or any other controlled, non-medically prescribed substance will not be allowed on the Project.

C. Rectify behavior unacceptable to the Owner or Owner's Project Representative by strict enforcement of discipline. Owner reserves the right to request dismissal of individual workers for failure to comply with standards of behavior communicated to the Contractor.

1.9 TAXES

A. The Contractor shall pay sales, use, payroll, unemployment, old age pension, or surtax applicable to this project.

B. The Owner shall pay taxes and assessments on real property comprising the site of this project.

1.10 MANUFACTURER'S DIRECTIONS

A. Manufactured articles, materials, or equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the Manufacturer's printed directions unless otherwise indicated in the Contract Documents.

1.11 FASTENERS

A. Unless noted otherwise, the trade requiring the fastening of its Work to any substrate or support is responsible for provision and installation of requisite fasteners.

1.12 PENETRATIONS

A. The sealing of all penetrations in fire-rated, acoustically rated or structural partitions and separations is the responsibility of the trade making or requiring the penetration.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 0000

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Owner-furnished products.
5. Access to site.
6. Work restrictions.
7. Specification and drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: TBD

1. Project Location: 1199 Highway 47, Hardin, MT 59034.

B. Architect: Prescott Muir Architects, 171 West Pierpont Ave., Salt Lake City, UT 84101.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. This is a Maverik convenience store/ gas station that is 5,982 square feet, an M occupancy classification, with a building type of V-B. The building has a large built-in cooler, basic food prep areas, merchandise areas, and a cashier station.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished Products:

1. As described on drawings.

1.6 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

1.8 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 01 1000

SECTION 01 2100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Requirements:

1. Section 01 4000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.9 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor s handling, labor, installation, overhead, and profit.

1. Do not include Contractor s or subcontractor s indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor s indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Per Bid Form.

END OF SECTION 01 2100

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 2100 "Allowances" for products selected under an allowance.

1.3 DEFINITIONS

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

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use acceptable form.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

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

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect s Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor s construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor s construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: Refer to owner requirements on bid documents.

B. Adjustment: Refer to owner requirements on bid documents.

1.6 CHANGE ORDER PROCEDURES

A. On Owner s approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a CCD. A CCD instructs Contractor to proceed with a change in the work, for subsequent inclusion in a change order.
1. CCD contains a complete description of change in the work. It also designates method to be followed to determine change in the contract sum or the contract time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the CCD.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

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SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 01 2100 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 01 3200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor s construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor s Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor s construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with continuation sheets.
   b. Submittal schedule.
   c. Items required to be indicated as separate activities in Contractor s construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

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

1. Identification: Include the following Project identification on the schedule of values:

   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

      1) Labor.
      2) Materials.
      3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

   a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the twentieth of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

    1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.

F. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

    1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

L. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Sustainable design submittal for project materials cost data.
4. Contractor's construction schedule (preliminary if not final).
5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
6. Products list (preliminary if not final).
7. Sustainable design action plans.
8. Schedule of unit prices.
9. Submittal schedule (preliminary if not final).
10. List of Contractor's staff assignments.
11. List of Contractor's principal consultants.
12. Copies of building permits.
13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
14. Initial progress report.
15. Report of preconstruction conference.
16. Certificates of insurance and insurance policies.
17. Performance and payment bonds.
18. Data needed to acquire Owner's insurance.

M. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.

2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor s Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor s Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Startup construction schedule.
2. Contractor s construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submitting schedules and reports.
2. Section 01 4000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

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

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

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

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

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.
3. Two paper copies.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor□s Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages, interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use of premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

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

1. Temporary enclosure and space conditioning.

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

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing.
    j. Punch list and final completion.
    k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

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

D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

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

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

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.5 REPORTS

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

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on

and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

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

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

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

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

END OF SECTION 01 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.

1.3 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage an adequate photographer to take construction photographs.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

D. Periodic Construction Photographs: Take min. 20 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take min. 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.

G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor s construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor s construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect s final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner**,** containing the following information:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Contractor.
e. Name of firm or entity that prepared submittal.
f. Names of subcontractor, manufacturer, and supplier.
g. Category and type of submittal.
h. Submittal purpose and description.
i. Specification Section number and title.
j. Specification paragraph number or drawing designation and generic name for each of multiple items.

k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number numbered consecutively.
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

D. Options: Identify options requiring selection by Architect.

E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer s catalog cuts.
    b. Manufacturer s product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.
    b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.
    b. Two opaque (bond) copies of each submittal. Architect will return one copy(ies).
    c. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer s color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer s product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic file.
    b. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."

G. Contractor s Construction Schedule: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 2900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturer's names.
5. Description of product.

6. Test procedures and results.
7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 7700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. "No Exceptions": Architect has no exceptions to submittal.
2. "Rejected": Architect rejects submittal.
3. "Furnish as Corrected": Architect has no exceptions to submittal as corrected.
4. "Revise and Resubmit": Architect requires submittal to be revised and resubmitted.
5. "Submit Specified Item": Architect requires specified item(s) to be submitted.

B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 3300

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

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

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 01 2100 "Allowances" for testing and inspecting allowances.

1.3 DEFINITIONS

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

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

C. 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.

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

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

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

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. 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).

I. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. 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.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 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, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
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 inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspection.

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. Name, address, and telephone number of technical representatives making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. 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. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

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

1.9 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.

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, 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.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

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

H. 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.

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

J. 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:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, 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.

1.10 QUALITY CONTROL

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

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

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."

D. 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.

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

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

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

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

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

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor s construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

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

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.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections 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.

END OF SECTION 01 4000

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SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 01 1000 "Summary" for limits on use of Project site.
2. Section 01 3300 "Submittal Procedures" for submitting surveys.
3. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

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

E. Certified Surveys: Submit two copies signed by land surveyor.

F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

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

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.

e. Mechanical systems piping and ducts.
f. Control systems.
g. Communication systems.
h. Fire-detection and -alarm systems.
i. Conveying systems.
j. Electrical wiring systems.
k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect s opinion, reduce the building s aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer s Installation Instructions: Obtain and maintain on-site manufacturer s written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility

appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

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

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer s written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

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

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

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

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

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

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

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

C. Temporary Support: Provide temporary support of work to be cut.

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

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 1000 "Summary."

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

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer s written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

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

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
b. Restore damaged pipe covering to its original condition.

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

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

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

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

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

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

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

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

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 9113 "General Commissioning Requirements."

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

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

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

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

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

END OF SECTION 01 7300

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SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 01 3233 "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Section 01 7300 "Execution" for progress cleaning of Project site.
3. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

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

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

4. Submit list of incomplete items in the following format:

a. MS Excel electronic file. Architect will return annotated file.
b. PDF electronic file. Architect will return annotated file.
c. Three paper copies. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

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

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Use cleaning products that comply with Green Seal® GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

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

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer s recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

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

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

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

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

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

END OF SECTION 01 7700

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SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 7300 "Execution" for final property survey.
2. Section 01 7700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one of file prints.
3) Submit record digital data files and one set(s) of plots.
4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.
3) Print each drawing, whether or not changes and additional information were recorded.

c. Final Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit record digital data files and three set(s) of record digital data file plots.
3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.

c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: Annotated PDF electronic file.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 01 3300 "Submittal Procedures" for requirements related to use of Architect's digital data files.
b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly

prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect□s reference during normal working hours.

END OF SECTION 01 7839

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SECTION 03 3000 - CAST-IN-PLACE CONCRETE

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

B. Related Requirements:

1. Section 32 1313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

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

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

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. 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 cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation,

methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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

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

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

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

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.
13. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

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

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

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

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

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

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

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

E. Mockups: Cast concrete slab-on-grade panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

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

1.9 DELIVERY, STORAGE, AND HANDLING

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

B. Water stops: Store water stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

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

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

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

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

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.

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.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

E. Deformed-Steel Wire: ASTM A 1064/A 1064M.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, Type IS, Portland blast-furnace slag cement.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Minimum to Maximum Coarse-Aggregate Size: 1 inch – 1-1/2-inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

G. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

H. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

I. Water: ASTM C 94/C 94M and potable.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Raven Industries, Inc.
b. Reef Industries, Inc.
c. Stego Industries, LLC.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034-inch-thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.9 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.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: See Structural Drawings.
2. Combined Fly Ash and Pozzolan: See Structural Drawings.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 45 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer□s written instructions.

1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. All normal weight and lightweight concrete:

1. Minimum Compressive Strength: As indicated in General Structural Notes.
2. Maximum Water-Cementitious Materials Ratio: As indicated in General Structural Notes.
3. Slump Limit: As indicated in General Structural Notes.
4. Air Content: As indicated in General Structural Notes.

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 ASTM C 1116/C 1116M, and furnish batch ticket information.

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

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Do not chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer s written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with Carborundrum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1-part Portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1-part Portland cement and 1-part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screening, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: [**5000 psi**] [**4500 psi**] [**4000 psi**] [**3500 psi**] [**3000 psi**] at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 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 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than age required per MFG instructions.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day□s pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day□s pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day□s pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency

may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

14. Additional testing and inspecting, at Contractor s expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 3000

SECTION 04 2000 - UNIT MASONRY

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. Stone.
2. Mortar and grout
3. Ties and anchors.
4. Embedded flashing.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Clay face brick, in the form of straps of five or more bricks.
2. Colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers□product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.
    a. Include data on material properties.
    b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    c. For exposed brick, include test report for efflorescence according to ASTM C 67.
    d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing according to ASTM C 67.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar. 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 C 91/C 91M for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Mockups: 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 wall area as shown on Drawings.
2. Clean exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

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. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. 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.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one Width of the masonry walls is completed in advance of other widths, secure cover a minimum of 24 inches down face next to unconstructed width 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 and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer S mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. Insulated CMUs: Where indicated, units shall contain rigid, specially shaped, cellular thermal insulation units complying with ASTM C 578, Type I, designed for installing in cores of masonry units.

D. CMUs: ASTM C 90.

1. Unit Compressive Strength: See Structural.
2. Density Classification: Normal weight.

3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

E. Decorative CMUs: ASTM C 90.

1. MFGS: Basis of Design – Amcor Masonry;
2. Unit Compressive Strength: See Structural.
3. Density Classification: Normal weight.
4. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
5. Pattern and Texture:

   a. Burnished.

6. Colors: Amcor Nutmeg.

2.4 CAST-STONE MATERIALS

A. General: Comply with ASTM C 1364.

B. Portland Cement: ASTM C 150/C 150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast-stone color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33/C 33M; gradation and colors as needed to produce required cast-stone textures and colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33/C 33M, gradation and colors as needed to produce required cast-stone textures and colors.

E. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

F. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Air-Entraining Admixture: ASTM C 260/C 260M.
4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.

G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast-stone material.

1. Epoxy Coating: ASTM A 775/A 775M.
2. Galvanized Coating: ASTM A 767/A 767M.

H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

2.5 CAST-STONE UNITS

A. MFG Products

1. Environmental Stoneworks.
2. Boral Stone Products, Cultured Stone.

B. Cast-Stone Units: Comply with ASTM C 1364.

C. 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 raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. 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 for 12 hours or 70 deg F 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 or above.
b. No fewer than six days at mean daily temperature of 60 deg F or above.
c. No fewer than seven days at mean daily temperature of 50 deg F or above.
d. No fewer than eight days at mean daily temperature of 45 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: As selected by Maverik from manufacturer's full range.

2.6 MORTAR AND GROUT MATERIALS

A. Basis of Design: Davis Colors True Tone MC64: Suede Medium

B. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

E. Cold-Weather Admixture: Non- chloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

F. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

E. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized carbon-steel continuous wire.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 641/A 641M, Class 1 coating.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.

3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
5. Meet seismic requirements.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snap lock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
6. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
8. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
9. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
10. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
11. Solder metal items at corners.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

2. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer s standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
b. Strips, not less than 3/4-inch-thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips, full depth of cavity and installed to full height of cavity.
d. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity, with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

2.11 MASONRY CLEANERS

A. 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.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use Portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use Portland cement-lime mortar.
4. For reinforced masonry, use Portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type N.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of Portland cement by weight.
2. Mix to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-width 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.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.

3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in One-Half running bond with vertical joint in each course centered on units in courses above and below; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each width at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

3.6 CAVITY WALLS

A. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

B. Purge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of purge coat smooth.

C. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing.

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.

3.8 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

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. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick Wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 9200 "Joint Sealants."

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.

C. Install weep holes in exterior Wythe's and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install cavity vents in head joints in exterior Wythe's at spacing indicated. Use specified weep/cavity vent products or open-head joints to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04 2000

SECTION 05 1200 - 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:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:
1. Section 05 3100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" and

1.3 DEFINITIONS

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

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 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.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

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.

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 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, [**Grade B**] [**Grade C**], structural tubing.

F. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

G. Steel Forgings: ASTM A 668/A 668M.

H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Unheaded Anchor Rods: As indicated in General Structural Notes.

1. Configuration: As Indicated.
2. Nuts: ASTM A 563 heavy hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Plain.

C. Threaded Rods: As indicated in General Structural Notes.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

D. Clevises Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

E. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

F. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER

A. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

B. Primer: SSPC-Paint 25 BCS, Type I, zinc oxide, alkyd, linseed oil primer.

C. Primer: SSPC-Paint 23, latex primer.

D. Primer: Fabricator□s standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

E. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

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

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

2.5 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.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened; Pretensioned; Slip critical.

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. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
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. SPC-SP 6/NACE No. 3, "Commercial 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. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, non - asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will 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.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment's for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedment's showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

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. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened; Pretensioned; Slip critical.

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. 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.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will 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: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 09 9600 "High-Performance Coatings."

END OF SECTION 05 1200

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SECTION 05 2100 - STEEL JOIST 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:

1. Steel joists.
2. Joist accessories.

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 04 2000 "Unit Masonry" for installing bearing plates in unit masonry.
3. Section 05 1200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

A. SJI "Specifications": Steel Joist Institute "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.

C. 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.

3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 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."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

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 indicated

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.2 STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Steel Joists" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

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. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated.

E. Steel bearing plates with integral anchorages are specified in Section 05 5000 "Metal Fabrications."

F. 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 of finished wall surface unless otherwise indicated.

G. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

H. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

I. Welding Electrodes: Comply with AWS standards.

J. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

K. 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 by hand-tool cleaning, SSPC-SP 2.

B. Do not prime paint joists and accessories.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

D. Shop priming of joists and joist accessories is specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.

3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection S "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709.
c. Ultrasonic Testing: ASTM E 164.
d. Radiographic Testing: ASTM E 94.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer s written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 2100

SECTION 05 3100 - STEEL DECKING

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. Roof deck.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 09 9113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
3. Section 09 9123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.

C. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Evaluation Reports: For steel deck.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

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."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASC Profiles, Inc.
2. Canam Steel Corporation; Canam Group, Inc.
3. Consolidated Systems, Inc.
4. DACS, Inc.

5. Nucor Corp.
6. Roof Deck, Inc.
7. Verco Decking, Inc., a Nucor company.

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

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade As indicated minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
2. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade As indicated G60 zinc coating.
3. Profile Depth: As indicated in General Structural Notes.
4. Design Uncoated-Steel Thickness: As indicated in General Structural Notes.
5. Span Condition: As indicated Triple span or more.
6. Side Laps: Interlocking seam

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile required.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

A. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inchthick, with factory-punched hole of 3/8-inch minimum diameter.

B. Galvanizing Repair Paint: ASTM A 780.

C. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As indicated in General Structural Notes.
2. Weld Spacing: As indicated in General Structural Notes.
3. Weld Washers: Install weld washers as required.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated in General Structural Notes.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum

D. 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.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 3100

SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.

B. Related Requirements:

1. Section 09 2216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. 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..

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 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, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

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."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AllSteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metal Products Co.
3. ClarkDietrich Building Systems.

4. Marino\WARE.
5. Nuconsteel, A Nucor Company.
6. Steeler, Inc.
7. United Steel Deck, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240of the wall height.
    b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft..

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of 3/4 inch.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

B. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As indicated in General Structural Notes
2. Coating: G60, or equivalent

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated in General Structural Notes
2. Flange Width: As indicated in General Structural Notes
3. Section Properties: As indicated in General Structural Notes

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated in General Structural Notes
2. Flange Width: As indicated in General Structural Notes

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated in General Structural Notes
2. Flange Width: As indicated in General Structural Notes
3. Section Properties: As indicated.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.

8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: As indicated

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. 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.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, 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: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI s specifications and standards, manufacturer s written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. 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 are required to obtain fire-resistance rating 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 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.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07 2100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As indicated

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Bridging: 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. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: 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. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

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

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 06 1000 - ROUGH CARPENTRY

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. Shear wall panels.
2. Rooftop equipment bases and support curbs.
3. Wood blocking and nailers.
4. Wood furring.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include

physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 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. Power-driven fasteners.
2. Post-installed anchors.
3. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 DIMENSION LUMBER FRAMING

A. See Structural notes on drawings.

2.3 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. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 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 of Type 304 stainless steel.

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.

2.5 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. 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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

E. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch-minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

2.6 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with

manufacturer's written instructions.

C. 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, and similar supports to comply with requirements for attaching other construction.

D. 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.

E. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

F. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. For interior partitions and walls, provide 2-by-4-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
3. Provide continuous horizontal blocking at mid height of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

D. Provide diagonal bracing in exterior walls, at both walls of each external corner walls, at locations indicated, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal-size boards, let-in flush with faces of stud’s metal wall bracing, let into studs in saw kerf.

3.5 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1000

SECTION 06 1600 - SHEATHING

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. Wall sheathing.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For 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 Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

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 International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. 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.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

END OF SECTION 06 1600

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SECTION 06 2013 - EXTERIOR FINISH CARPENTRY

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. Manufactured siding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer s written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:

1. For each panel products, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.

3. For fire-retardant-treated wood that is not marked with classification marking of testing and inspecting agency.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

C. Sample Warranties: For manufacturer s warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

1. For exterior ornamental wood columns, comply with manufacturer s written instructions and warranty requirements.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 WARRANTY

A. Manufacturer s Warranty for Cellular PVC Trim: Manufacturer agrees to repair or replace trim that fails due to defects in manufacturing within specified warranty period. Failures include, but are not limited to, deterioration, delamination, and excessive swelling from moisture.

1. Warranty Period: 25 years from date of Substantial Completion.

B. Manufacturer's Warranty for Hardboard Siding: Manufacturer agrees to repair or replace siding that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, deformation or deterioration beyond normal weathering.

1. Warranty Period for Factory-Applied Finish: Five years from date of Substantial Completion.
2. Warranty Period for Siding (Excluding Finish): 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated.

B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

C. Softwood Plywood: DOC PS 1.

D. Hardboard: ANSI A135.4.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Water-Repellent Preservative Treatment by Nonpressure Process: AWPA N1; dip, spray, flood, or vacuum-pressure treatment.

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chloropyrifos (CPF).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Application: Items not required to be pressure-preservative treated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.

B. 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, 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 beyond the centerline of the burners at any time during the test.

1. Exterior Type: Materials shall comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
2. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application: Where indicated.

2.4 EXTERIOR TRIM

A. Exterior Trim - Basis of Design:

LP SmartSide: Cedar Texture Trim – 540 Series – 2.5” x .625” – 25878 Batten Strips.

Color: Basis of design – Colorguard: Sable Brown, Suede, Desert Tan

2.5 PANEL SIDING

A. Panel Siding - Basis of Design:

LP SmartSide – Panel Siding – Cedar Textured Panel:
38 Series Cedar Textured Panel – No Groove Strand

Color: Basis of design – Colorguard: Sable Brown, Suede, Desert Tan

2.6 WOOD SOFFIT

A. T1-11 Douglas Fir

Stain to match Timbers

2.7 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

1. Horizontal Joint Flashing for Panel Siding: Preformed, galvanized-steel, Z-shaped flashing.

D. Sealants: Latex, complying with ASTM C 834 Type OP, Grade NF and applicable requirements in Section 07 9200 "Joint Sealants" and recommended by sealant and substrate manufacturers for intended application.

2.8 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 09 9113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
3. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
4. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.6 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 2013

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SECTION 06 6400 - PLASTIC PANELING

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. Plastic sheet paneling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 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 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Composites, Inc.
   b. Glasteel.
   c. Marlite.
   d. Newcourt, Inc.
   e. Nudo Products, Inc.
   f. Parkland Plastics, Inc.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.075 inch.
4. Surface Finish: Textured.
5. Color: White.
6. Height: 12-Foot

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer□s standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, [**outside corners,**] and caps as needed to conceal edges.

1. Color: White.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

1. Adhesives shall have a VOC content of 50 g/L or less.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "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, lose 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 so that trimmed panels at corners are not less than 12 inches wide.

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 and nails or staples. 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 06 6400

SECTION 07 2100 - THERMAL INSULATION

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. Extruded polystyrene foam-plastic board.
2. Polyisocyanurate foam-plastic board.
3. Glass-fiber blanket.

B. Related Requirements:

1. Section 04 2000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 06 1600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 07 5419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer s written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Atlas Roofing Corporation.
   b. Dow Chemical Company (The).
   c. Hunter Panels.
   d. Rmax, Inc.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

B. Encapsulated: Required in locations as noted on drawings (behind beverage and beer coolers, behind electrical panels, etc.) Locations where required to have 'encapsulated' insulation are not required to be faced with foil-scrim-kraft, foil-scrim, or flil-scrim-polyethylene vapor- retarder membrane on one face. Encapsulate insulation is used in these locations to prevent water damage before roof can be dried in.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corporation (Easy Touch)
b. Johns Manville; a Berkshire Hathaway company (ComfortTherm)

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.
b. Gemco.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Gemco.

2. Angle: Formed from 0.030-inch-thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.
b. Gemco.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Crawl spaces.
b. Ceiling plenums.
c. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space as shown on documents between face of insulation and substrate to which anchor is attached.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Gemco.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.
b. Gemco.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

B. 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 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 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.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation 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 24 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.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.

4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or damp proofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 2000 "Unit Masonry."

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.
    a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
    b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb./cu. ft.

C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

3.7 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 07 2100

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SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

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 fluid-applied, membrane air barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. 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.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: membrane.

1. Synthetic Polymer Membrane:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Dryvit - BACKSTOP NT - Spray.

2) ParexUSA – Weather Seal Spray & Roll-on

3) Weathertech WRBS – Weather seal

4) STO – Emerald Coat

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer s written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. 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.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in one or more equal coats.

C. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish mouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

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 [**30**] [**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.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 2726

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SECTION 07 4113.16 - STANDING-SEAM METAL ROOF PANELS

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 standing-seam metal roof panels.

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 panel and accessory.

B. Shop Drawings:

1. 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.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturers 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. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips inside laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following or comparable product by one of the following:

a. MBCI; a division of NCI Group, Inc. LOKSEAM – SIGNATURE 300.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: 24 Gauge.

b. Exterior Finish: Two-coat fluoropolymer.
c. Color: Signature 300 – Dark Bronze.

3. Clips: Standard and UL90 from MFG to accommodate thermal movement.

4. Panel Coverage: 18 inches - LOKSEAM.
5. Panel Height: 1.75 inches.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.

B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer□s recommended slip sheet, of type required for application.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 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, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

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, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb sub framing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and sub framing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch-thick, rigid insulation.

G. Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install sub framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 6200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.

6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
4. Stainless-Steel Panels: Use stainless-steel fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturer's written instructions.

D. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

G. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to leave with gutter hangers spaced not more than 36 inches o.c. using manufacturer□s standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

H. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

I. Roof Curbs: Install flashing around bases where they meet metal roof panels.

J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer□s Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor□s expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

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.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4113.16

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SECTION 07 4293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit 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.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. 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.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or another surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than as described by Structural of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. 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.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners inside laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product listed:

a. MBCI; a division of NCI Group, Inc. MBCI Artisan Series L-12

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: Per MFG.
b. Exterior Finish: Signature 300, Kynar 500, Hylar 5000, Low Gloss.
c. Color: Snow White.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub framing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 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, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or

Pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

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. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2-inch-wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form non - expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent 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.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.

    a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install sub framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

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.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4293

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SECTION 07 4610 - HARDIE BOARD SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiber cement lap siding, panels, shingle, trim, fascia, molding and accessories; James Hardie HZ5 Engineered for Climate Siding.

B. Factory-finished fiber cement lap siding, panels, shingle, trim, fascia, molding and accessories; James Hardie HZ5 Engineered for Climate Siding.

1.2 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer s data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer s full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of 2 years' experience with installation of similar products.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer s unopened packaging until ready for installation.

B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

C. Store and dispose of solvent-based materials, and materials used with solvent-based

materials, in accordance with requirements of local authorities having jurisdiction.

1.5 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 absolute limits.

1.6 WARRANTY

A. Product Warranty: Limited, non-pro-rated product warranty.
1. HardiPanel HZ5 vertical siding for 30 years.

B. Product Warranty: Limited, product warranty.
1. HardieTrim HZ and HZ5 boards for 15 years.

C. Finish Warranty: Limited product warranty against manufacturing finish defects.
1. When used for its intended purpose, properly installed and maintained according to James Hardie s published installation instructions, James Hardie s ColorPlus finish with ColorPlus Technology, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip. Finish warranty includes the coverage for labor and material.

D. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Fax: 949-367-4981; Email: request info (info@jameshardie.com); Web: www.jameshardiecommercial.com

B. Substitutions: Not permitted.

C. Requests for approval of equal substitutions will be considered in accordance with provisions of Section 01600.

2.2 SIDING

A. Vertical Siding: HardiePanel HZ5 siding as manufactured by James Hardie Building Products, Inc.
1. Type: Cedarmill Vertical siding panel 4 feet by 10 feet (1219 mm by 3048 mm).

B. Trim:
1. HardieTrim HZ5 boards and HardieTrim HZ boards as manufactured by James Hardie Building Products, Inc.
a. 1” x (5.5” – 11.25”) x 12’ trim.

C. Batten Strips:
1. HardieTrim HZ5 boards and HardieTrim HZ boards as manufactured by

James Hardie Building Products, Inc. a. 3/4" x 2.5" x 12' trim.

2.3 FASTENERS

A. Wood Framing Fasteners: Confirm as required by Hardie.

B. Metal Framing: Confirm as required by Hardie.

C. Masonry Walls (CMU): Confirm as required by Hardie.

2.4 FINISHES

A. Factory Primer: Provide factory applied universal primer.
   1. Primer: Factory primed by James Hardie.
   2. Topcoat: Refer to Section 09900 and Exterior Finish Schedule.

B. Factory Finish: Refer to Exterior Finish Schedule.
   1. Product: ColorPlus Technology by James Hardie.
   2. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
   3. Process:
      a. Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing process.
      b. Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photo spectrometer and verified by third party.
   4. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed
   5. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.

C. Factory Finish Color for Trim, Soffit and Siding Colors:

   1. Cobble Stone.
   2. Aged Pewter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Nominal 2 inch by 4-inch (51 m by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-

resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

1. Install water-resistive barriers and claddings to dry surfaces.
2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
3. Protect siding from other trades.

D. Minimum 20 gauge 3-5/8 inch (92 mm) C-Stud 16 inches maximum on center or 16 gauge 3-5/8 inches (92 mm) C-Stud 24 inches (610 mm) maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

1. Install water-resistive barriers and claddings to dry surfaces.
2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
3. Protect siding from other trades.

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.

C. Install a water-resistive barrier is required in accordance with local building code requirements.

D. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

E. Install Engineered for ClimateTM HardieWrapTM weather barrier in accordance with local building code requirements.

F. Use HardieWrapTM Seam Tape and joint and laps.

G. Install HardieWrapTM flashing, and HardieWrapTM Flex Flashing

3.3 INSTALLATION - HARDIEPANEL HZ5 VERTICAL SIDING

A. Install materials in strict accordance with manufacturer s installation instructions.

B. Block framing between studs where HardiePanel siding horizontal joints occur.

C. Install metal Z flashing and provide a 1/4-inch (6 mm) gap at horizontal panel joints.

D. Place fasteners no closer than 3/8 inch (9.5 mm) from panel edges and 2 inches (51 mm) from panel corners.

E. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer s installation instructions.

F. Maintain clearance between siding and adjacent finished grade.

G. Specific framing and fastener requirements refer to Tables 2 and 3 in National Evaluation Service Report No. NER-405.

H. Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer s printed instructions.
   1. Touch-up nicks, scrapes, and nail heads in pre-finished siding using the manufacturer s touch-up kit pen.
   2. Touch-up of nails shall be performed after application, but before plastic protection wrap is removed to prevent spotting of touch-up finish.
   3. Use touch-up paint sparingly. If large areas require touch-up, replace the damaged area with new pre-finished siding. Match touch up color to siding color through use of manufacturer s branded touch-up kits.

3.4 INSTALLATION - HARDIETRIM HZ5 BOARDS

A. Install materials in strict accordance with manufacturer s installation instructions. Install flashing around all wall openings.

B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

C. Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.

D. Maintain clearance between trim and adjacent finished grade.

E. Trim inside corner with a single board trim both side of corner.

F. Outside Corner Board Attach Trim on both sides of corner with 16 gage corrosion resistant finish nail 1/2 inch (13 mm) from edge spaced 16 inches (406 mm) apart, weather cut each end spaced minimum 12 inches (305 mm) apart.

G. Allow 1/8-inch gap between trim and siding.

H. Seal gap with high quality, paint-able caulk.

I. Shim frieze board as required to align with corner trim.

J. Fasten through overlapping boards. Do not nail between lap joints.

K. Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten HardieTrim boards to HardieTrim boards.

L. Shim frieze board as required to align with corner trim.

M. Install HardieTrim Fascia boards to rafter tails or to sub fascia.

3.5 FINISHING

A. Finish unprimed siding with a minimum one coat high quality, alkali resistant primer

and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer s written product recommendation and written application instructions.

B. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer s written product recommendation and written application instructions.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 5419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered polyvinyl-chloride (PVC) roofing system.
2. Mechanically fastened polyvinyl-chloride (PVC) roofing system.
3. Roof insulation.
4. Walkway pads.

B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 05 3100 "Steel Decking."

C. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 06 1600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof flashings and counter flashings.
4. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
5. Walkway pads.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer s special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. 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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer s name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer s written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer s written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion NDL (no dollar limit).

B. Special Project Warranty: Submit roofing Installer s warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

C. SPRI Wind Design Standard: Manufacture and install copings, roof edge flashings tested according to SPRI ES-1.

D. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

E. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:

1. Corner Uplift Pressure: As required to meet Class 1A-90.
2. Perimeter Uplift Pressure: As required to meet Class 1A-90.
3. Field-of-Roof Uplift Pressure: As required to meet Class 1A-90.

F. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: MH.

G. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 PVC ROOFING

A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. GAF
b. Carlisle SynTec Incorporated
c. Duro-Last Roofing, Inc.
d. Sika Sarnafil

2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having

jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Bonding Adhesive: Manufacturer's standard.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, pre-punched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. 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.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3100 "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

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.

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.

3.5 VAPOR-RETARDER INSTALLATION

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

1. Where installing composite and non-composite insulation in two or more layers, install non-composite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Loosely Laid Insulation: Loosely lay insulation units over substrate.

K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

L. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written

instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5036.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5082.
2. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing with side laps shingled with slope of roof deck where possible.

F. 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.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and

sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.9 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.

3.10 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).

B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
2. Flood each area for 24 hours.

3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 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 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 07 5419

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SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured through-wall flashing with snap lock receiver.
2. Manufactured reglets with counterflashing.
3. Formed roof-drainage sheet metal fabrications.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood nailer's, curbs, and blocking.
2. Section 07 7200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer□s personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 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 manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or another surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 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 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

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. FM Approvals Listing: Manufacture and install copings 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.

D. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature

changes to prevent 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.

1. Temperature Change: 120 deg F, ambient; 180 deg F, 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. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. As-Milled Finish: Mill.

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent 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.

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.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

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 or manufactured item 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 or manufactured item.

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 Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. 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, non-staining tape 1/2-inch-wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with snap lock receiver on exterior face to receive counterflashing.

1. Stainless Steel: 0.016 inch thick.

B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
1. Material: Stainless steel, 0.019 inch thick.
2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
3. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Accessories:

a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

7. Finish: Mill.

2.6 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. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. 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.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. 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 deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. 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.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. 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.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

K. Do not use graphite pencils to mark metal surfaces.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form

with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.019 inch thick.
   2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 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, 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 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.
6. Do not use graphite pencils to mark metal surfaces.

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 uncoated-aluminum and 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 with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch 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 for nails and not less than 3/4 inch for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

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.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to

interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

C. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant interlocking folded seam or blind rivets and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 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.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 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. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 6200

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Reglets and counter flashings.
3. Gutters.

B. Related Requirements:
1. Section 06 1000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 7200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
3. Section 07 9200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

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.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer s standard sizes.
2. Include copings reglets and counter flashings made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For copings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer s special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or another surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals markings.

C. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.063 inch thick.

a. Surface: Smooth, flat finish.
b. Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

B. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet, with a horizontal flange and vertical leg fascia, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

1. Formed Aluminum Sheet Gravel Stops: Aluminum sheet, 0.050 inch thick.

a. Surface: Smooth, flat finish.
b. Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

2. Corners: Factory mitered and soldered.
3. Accessories: Fascia extenders with continuous hold-down cleats.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Aluminum Sheet: 0.032 inch thick.
2. Gutter Profile: As indicated according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and mechanically clinched and sealed watertight.
4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
5. Gutter Accessories: Continuous screened leaf guard with sheet metal frame.

2.4 REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Formed Aluminum: 0.024 inch thick.
2. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

3. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
5. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

B. Counter flashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Formed Aluminum: 0.032 inch thick.

C. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.5 MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.6 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils 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.

1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.

B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer□s recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent 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.
    b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Two-Coat Mica Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent 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.
    d. Three-Coat Metallic Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    e. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings roof-edge specialties and reglets and counter flashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer□s written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayment's, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

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 specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer□s required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of Snap-On coping cap into cleated anchor plates anchored to substrate at manufacturer□s required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer□s required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer□s required spacing that meets performance requirements.

3.5 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.6 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal or solder exterior wall scupper flanges into back of conductor head.

3.7 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counter flashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counter flashings overlap 4 inches over top edge of base flashings.

C. Counter flashings: Insert counter flashings into reglets or other indicated receivers; ensure that counter flashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counter flashings tightly to base flashings.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On

completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7100

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof hatches.

B. Related Sections:

1. Section 07 6200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

4. Required clearances.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.8 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 specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

2.2 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. Polyisocyanurate Board Insulation: ASTM C 1289, 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 thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Underlayment:

1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D 4397.
3. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

F. 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:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

G. 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.

H. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane 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.

I. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

J. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF HATCH – (When Used)

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, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Babcock-Davis.
    b. Bilco Company (The).
    c. Nystrom.
    d. O'Keeffe's Inc.

B. Type and Size: Single-leaf lid, 30 by 36 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Aluminum sheet, 0.090 inch thick.

1. Finish: Mill.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Polyisocyanurate board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.

F. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches.
2. Provide remote-control operation.

G. 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 above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch-diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

    a. Color: As selected by Architect from manufacturer's full range.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: 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, excessive oil canning, 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 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 felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof-hatch curb.
4. Attach ladder-assist post according to manufacturer s written instructions.

F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

C. Clean exposed surfaces according to manufacturer s written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

    a. Control and expansion joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors and windows.
    f. Control and expansion joints in ceiling and overhead surfaces.
    g. Control and expansion joints in Portland cement concrete pavement, walks, and curbs.
    h. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:

    a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
    b. Joints between different materials listed above.
    c. 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 control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    g. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:

    a. Control and expansion joints in cast-in-place concrete slabs.
    b. Control and expansion joints in tile flooring.
    c. Other joints as indicated.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 7 Section "Flashing and Sheet Metal" for sealing joints related to flashing and sheet metal for roofing.
3. Division 8 Section "Glazing" for glazing sealants.
4. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
5. Division 9 Section "Tile" for sealing tile joints

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates or adjoining materials.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates or adjoining materials.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: From manufacturer for each joint-sealant product required.

C. Samples for Initial Selection: In form of manufacturer's bead samples, consisting of strips of actual products showing custom colors to match Architect's sample or to match the adjoining surfaces in a manner determined by the Architect.

D. Actual Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

H. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

I. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

J. Warranties: Submit sample warranty to be signed jointly by applicator and manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer. If sealants from separate manufacturers must be used and could come in contact with each other, provide written certification from all manufacturers involved that the sealants are compatible and will adhere to each other.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

    a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit not fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint sealant manufacturer s written instructions for corrective measures, including the use of specially formulated primers.5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are acceptable to Architect and that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 24-month period .preceding date of Contractor s submittal of test results to Architect.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods. Include test

results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, modulus of elasticity at 100 percent strain, effecs of heat aging, and effects of accelerated weathering.3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

4. Include test results performed on joint sealants after they have cured for 1 year.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

D. Areas where waterproofing and joint sealants are used together, sequence the installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated or recommended by the waterproofing manufacturer.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing 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.

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing 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: 20 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers, 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: Match Architect's samples or to match the adjoining surfaces in a manner to be determined and approved by the Architect.

C. Where Compound is Not Exposed to View: Provide manufacturer's standard color which has the best overall performance characteristics for application needed.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion

and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Available Products: Subject to compliance with requirements, joint sealant schedule, and manufacturer s recommendations, provide one of the products specified in each category below where needed:

1. Elastomeric Joint Sealant Designation: ES1

   a. Base Polymer: Urethane.
   b. Type: M (multicomponent).
   c. Grade: P (pourable).
   d. Class: 25.
   e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
   f. Use[s] Related to Exposure: T (traffic).
   g. Uses Related to Joint Substrates: M (mortar) and, as applicable to joint substrates indicated, O (other).
   h. Products:

      1) Sikaflax - 2c SL

2. Elastomeric Joint Sealant Designation: ES2

   a. Base Polymer: Neutral-curing silicone.

   b. Type: S (single component).
   c. Grade: NS (nonsag).
   d. Class: 25.
   e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
   f. Use[s] Related to Exposure: NT (nontraffic).
   g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
   h. Products:

      1) Dow Corning 795
      2) GE Silpruf

3. Elastomeric Joint Sealant Designation: ES3

   a. Base Polymer: Urethane.

   b. Type: M (multi-component).
   c. Grade: NS (nonsag).

d. Class: 25.

e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
f. Use[s] Related to Exposure: NT (nontraffic).
g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
h. Products:

1) Mameco Vulkem 922
2) Sikaflex 2C

4. Elastomeric Joint Sealant Designation: ES4

a. Base Polymer: Acid-curing silicone.

b. Type: S (single component).
c. Grade: NS (nonsag).
d. Class: 25.
e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
f. Use[s] Related to Exposure: NT (nontraffic).
g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
h. Products:

1) Dow Corning 999-A
2) GE Contractors 1200
3) Pecora 863

5. Elastomeric Joint Sealant Designation: ES5

a. Base Polymer: Acid-curing, mildew-resistant silicone.

b. Type: S (single component).
c. Grade: NS (nonsag).
d. Class: 25.
e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
f. Use[s] Related to Exposure: NT (nontraffic).
g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
h. Products:

1) Mameco Vulkem 922
2) Sikaflex 2C

4. Elastomeric Joint Sealant Designation: ES4

a. Base Polymer: Acid-curing silicone.

b. Type: S (single component).
c. Grade: NS (nonsag).

d. Class: 25.
e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
f. Use[s] Related to Exposure: NT (nontraffic).
g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
h. Products:

1) Dow Corning 999-A
2) GE Contractors 1200
3) Pecora 863

5. Elastomeric Joint Sealant Designation: ES5

a. Base Polymer: Acid-curing, mildew-resistant silicone.

b. Type: S (single component).
c. Grade: NS (nonsag).
d. Class: 25.
e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
f. Use[s] Related to Exposure: NT (nontraffic).
g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
h. Products:

1) Dow Corning - Trademate Tile and Ceramic
2) GE - Sanitary 1700

2.4 LATEX JOINT SEALANTS

A. General: For interior locations only and where movement capacity and weathering characteristics are not critical, provide manufacturer s standard one-part, nonsag, mildew-resistant, paintable latex sealant of either acrylic or silicone emulsion formulation indicated that is recommended for exposed applications on interior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively orcohesively.

B. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

C. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:

1. Latex Joint Sealant Designation: LS1

a. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
b. Products:

1) "AC-20," Pecora Corp.
2) "Sonolac," Sonneborn Building Products Div., ChemRex, Inc.

2. Latex Joint Sealant Designation: LS2

a. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.
b. Products:

1) "Trade Mate Paintable Glazing Sealant," Dow Corning Corp.

2.5 ACOUSTICAL JOINT SEALANTS

A. General: Use only at interior locations as indicated on drawings.

B. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

D. Available Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Joint Sealant Designation: AS1

a. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:

1) Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
2) Product has flame spread and smoke developed rating of less than 25 per ASTM E 84.

b. Products:

1) "Sheetrock Acoustical Sealant," United States Gypsum Co.
2) "AC-20 FTR Acoustical and Insulation Sealant," Pecora Corp.

2. Acoustical Joint Sealant Designation: AS2

a. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying,

nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.

b. Products:

1) "BA-98," Pecora Corp.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, non-out gassing in unruptured state.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 JOINT FILLERS FOR CONCRETE PAVING

A. General: Provide joint fillers of thicknesses and widths indicated.

B. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D 1751:

1. Asphalt saturated fiberboard.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance. Remove dirt, insecure coatings, moisture and other substances which would interfere with proper bond of sealant or caulking compound.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Similar porous surfaces.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint fillers.
2. Do not stretch, twist, puncture, or tear joint fillers.
3. Remove absorbent joint fillers that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where backer rods are not used between sealants and joint filler, or back of joints.

F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in

which joints occur.

B. Clean facade sealants, that show dirt at the time of substantial completion, over the entire facade prior to acceptance by the Owner. Verify that sealant joints do not show dirt 10 months after final completion of the building and repeat cleaning process over entire facade if dirt is observed.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 JOINT SEALANT SCHEDULE

JOINT SEALANT SCHEDULE		
DESIGNATION ON DATA SHEETS	**JOINT SEALERS**	**DESCRIPTION OF JOINT CONSTRUCTION AND LOCATION WHERE SEALANT IS TYPICALLY APPLIED**
ES-1	Multi-part Pourable Urethane Sealant	Exterior and interior horizontal joints subject to traffic such as expansion joints in tile, pavers and sidewalks.
ES-2	One-Part Neutral Cure Silicone Sealant	Exterior and interior joints in vertical surfaces of concrete and masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints. Joints which are bordered by glass.
ES-3	Multi-component Urethane Sealant	Exterior and interior joints in vertical surfaces of concrete masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints.
ES-4	One-Part Acid Curing Silicon	Exterior and interior joints in vertical surfaces of non-porous surfaces. To be used on exterior and interior perimeter frames of walls and control and expansion and window joints. Between metal to metal, glass to glass, metal to glass, travertine to travertine, cap beads on glass.
ES-5	One-Part Mildew Resistant Silicone Sealant	Interior joints in vertical surfaces of ceramic tile in toilet rooms.
LS1/LS2	Latex Sealant	Exposed interior applications.
AS1	Acoustical Sealant	Exposed interior applications.
AS2	Acoustical Sealant	Unexposed interior applications.
Notes:	1. Install sealant in joints fitting descriptions and locations listed. 2. "LS1 and LS2" are for interior use only and are to be applied only if an "ES" designation is not otherwise indicated and where movement capacity and weathering characteristics are not critical. 3. Either ES2 or ES3 may be used at contractors' option where recommended by manufacturer. 4. If locations are encountered that are not described above, sealant manufacturer's recommendations are to be followed. The issue is to be brought to the attention of the Architect and General Contractor in writing. The appropriate sealant shall be submitted as part of the submittal process.	

END OF SECTION 07 9200

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08 7100 "Finish Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.

8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

B. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:

a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Amweld International, LLC.
2. Ceco Door; ASSA ABLOY.
3. Curries Company; ASSA ABLOY.
4. Gensteel Doors, Inc.
5. Steelcraft; an Allegion brand.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
    d. Edge Construction: Model 2, Seamless.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
    f. Core: Kraft-paper honeycomb.

3. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

4. Exposed Finish: Factory.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3..

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.

d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
f. Core: Kraft-paper honeycomb.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Full profile welded.

4. Exposed Finish: Factory.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Post installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hotdip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hotdip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 08 8000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
4. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with

published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
        1) Three anchors per jamb from 60 to 90 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        1) Four anchors per jamb from 60 to 90 inches high.

    c. Compression Type: Not less than two anchors in each frame.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

8. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   b. Install frames with removable stops located on secure side of opening.
   c. Install door silencers in frames before grouting.
   d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible

on exposed faces.

7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer s written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer s written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer s written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer s written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in

painting Sections.

END OF SECTION 08 1113

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior storefront framing.

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. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. 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. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Mockup Testing Submittals:

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data: For Installer.

C. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

D. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 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 and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

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.

D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
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.

1.9 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. Failures include, but are not limited to, the following:

    a. Structural failures including, but not limited to, excessive deflection.
    b. Noise or vibration created by wind and thermal and structural movements.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    d. Water penetration through fixed glazing and framing areas.
    e. Failure of operating components.

2. Warranty Period: 10 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. Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five 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 01 4000 "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, story drift, 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: As indicated on Drawings.

2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

    a. Operable Units: Provide a minimum 1/16-inch 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 for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including 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. at a static-air-pressure differential of 6.24 lbf/sq. ft.

2. Entrance Doors:

    a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

    b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

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 when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft.

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft.
2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

J. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

K. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15 as determined according to NFRC 500.

L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows.

1. Outdoor-Indoor Transmission Class: Minimum 30.

M. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

N. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.

O. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed storefront system without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Kawneer North America; an Alcoa company.
   a. 451-UT.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

   a. Sheet and Plate: ASTM B 209.
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

    a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 INSULATED SPANDREL PANELS

A. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

1. Overall Panel Thickness: As indicated.
2. Exterior Skin: Aluminum.

    a. Thickness: Manufacturer's standard for finish and texture indicated.
    b. Finish: Match framing system.
    c. Texture: Smooth.
    d. Backing Sheet: 1/8-inch-thick, tempered hardboard.

3. Interior Skin: Aluminum.

    a. Thickness: Manufacturer's standard for finish and texture indicated.
    b. Finish: Matching storefront framing.
    c. Texture: Smooth.
    d. Backing Sheet: 1/8-inch-thick, tempered hardboard.

4. Thermal Insulation Core: Manufacturer's standard rigid, closed cell, polyisocyanurate board.

B. 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.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
    b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Continuous-Gear Hinges: Manufacturer s standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

F. Manual Flush Bolts: BHMA A156.16, Grade 1.

G. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

H. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

I. Cylinders: As specified in Section 08 7100 "Door Hardware."

J. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for

aluminum framing.

K. Operating Trim: BHMA A156.6.

L. Removable Mullions: BHMA A156.3, extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

M. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

N. Concealed Overhead Holders: BHMA A156.8, Grade 1.

O. Surface-Mounted Holders: BHMA A156.16, Grade 1, with adjustable back check, and automatic hold open.

P. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

Q. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

R. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

S. Silencers: BHMA A156.16, Grade 1.

T. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

V. Push Bars: As selected by Architect from manufacturer's full range.

W. Pull Handles: As selected by Architect from manufacturer's full range.

2.7 GLAZING

A. Glazing: Comply with Section 08 8000 "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: Comply with Section 08 8000 "Glazing."

D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

1. Color: Match structural sealant.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. 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 exterior.
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.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers written instructions.

1. Color and Gloss: Dark Bronze Anodized.

2.11 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 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 07 9200 "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 08 8000 "Glazing."

G. Install weather seal sealant according to Section 07 9200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. 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.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the

following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces about in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two areas on each building facade.
2. Repair installation areas damaged by testing.

D. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner s continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide twelve months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective

components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 4113

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MAVERIK - HARDIN
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HARDIN, MT

SECTION 08 4600 - AUTOMATIC ENTRANCE DOORS

PART 1- GENERAL

1.1 SUMMARY

A. WORK INCLUDED:

1. Furnish and install automatic aluminum door system(s), factory fabricated.
2. Door packages shall be complete and without damage or defect.

B. Related Sections:

1. Section 07900- Joint Sealers
2. Section 08400 -Entrances & Storefronts
3. Section 08700- Hardware
4. Section 08800 - Glazing
5. Section 16000 - Electrical

C. DEFINITIONS:

1. Retain definition(s) remaining after this Section has been edited.
2. AAADM: American Association of Automatic Door Manufacturers.
3. Activation Device: Device that, when actuated, sends an electrical signal to the door Operator to open the door.
4. IBC: International Building Code.
5. Safety Device: Device that, to avoid injury, prevents a door from opening or closing.
6. Retain first option in paragraph below for sliding, swinging, or folding power-operated Doors; retain second option for power-assist and low-energy doors.
7. For automatic door terminology, refer to BHMA A156.10 and BHMA A156.19 for Definitions of terms.

1.2 RELATED WORK

A. Preparation of the plumb and square opening.

B. Floor preparation.

C. Electrical supply and connection (dedicated 120 VAC, 15 amp circuit to each operator/header)

1.3 PERFORMANCE REQUIREMENTS

A. Temperature change suitable:

1. minus 30 degree Fahrenheit (minus 34 degree Celsius) to
2. 130 degree Fahrenheit (54 degree Celsius)

B. Breakaway door requirements of not more than 50 lbf (222 N) provided power fails and no more than 15lbf (67 N) to open door to specified minimum required width.

C. Closing force of no more than 30 lbf (133 N) required preventing the door from closing at all times.

1.4 SUBMITTALS

A. PRODUCT DATA: Provide complete product and installation documentation as provided by the manufacturer.

B. SHOP DRAWINGS: Provide details of door construction including profiles, dimensioned layout, and assembly including finish, glazing, electrical, and anchoring requirements.

C. Provide manufacturer S Warranty documentation and Owner S Manual.

1.5 QUALITY ASSURANCE

A. Manufacturer must have a minimum of five (5) years of experience in the fabrication of Aluminum and glass door assembly similar to those specified. Door packages shall be warranted against defect in material and workmanship for a period of one year from the date of installation. Installation shall be approved by an AAADM certified inspector.

B. Door shall be self-certified to meet performance design criteria of the following standards.

1. ANSI/BHMA 156.10
2. NFPA 101
3. UL 325
4. CUL
5. IBC
6. ICBO
7. BOCA

C. Door shall be obtained solely through an authorized trained and factory certified automatic door provider.

1.6 PROJECT CONDITIONS

A. Approved Shop drawings must be referenced and confirmed by the General Contract or before fabrication.

B. Opening must be verified to be plumb, straight and secure.

C. It is the duty of the General Contractor to make door installer aware of any non-conforming

conditions or equipment as indicated on the shop drawings.

D. General Contractor is required to coordinate the layout and installation of the automatic door equipment connection to power supplies.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Faulty operation of operators, controls, and hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

1.8 REFERENCES

A. UNDERWRITERS LABORATORIES (UL):

1. UL 325- Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

B. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA):

1. ANSIIBHMA A156.10: Standard for Power Operated Pedestrian Doors.

C. American Society for Testing and Materials (ASTM):

1. ASTM B221 -Standard Specification for Aluminum and Aluminum- Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. American Association of Automatic Door Manufacturers (AAADM):

E. National Fire Protection Association (NFPA):

1. NFPA 101- Life Safety Code.
2. NFPA 70- National Electric Code.

F. International Code Council (ICC):

1. IBC: International Building

G. Building Officials and Code Administrators International (BOCA), 1999:

H. International Conference of Building Officials (ICBO):

1. IBC 2018: International Building Code.

I. National Association of Architectural Metal Manufacturers (NAAMM):

1. Metal Finishes Manual for Architectural and Metal Products.

J. American Architectural Manufacturers Association (AAMA):

1. AAMA 607. 1 - Clear Anodic Finishes for Architectural Aluminum.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Stanley Access Technologies, LLC.
14918 S. Concord Park Drive
Bluffdale, UT 84065
801-230-8941

Dura-Glide 2000/3000 Series - Job# 77296

Mike Carroll, 801-230-8941, mike.carroll@sbdinc.com.

B. Gildor Automatic Doors

C. Access Door Systems
NABCO Automatic Door Entrances

Chad Higley, 385-707-3264, chad@accessdoorsutah.com

2.2 SLIDING AUTOMATIC ENTRANCES

A. Sliding door Package: The manufacturer s sliding door package shall consist of the following materials in order to make a complete package installation: framing, flush mounted header (mounted between jambs), sliding door panel(s), stationary panel(s), operators (belt drive only linear rod not accepted), activation and safety devices, carrier assemblies, noise isolating roller track, threshold, and guide tracks (to match threshold dimensions on full breakout units). Traffic patterns to be determined by owner and set by installer.

B. Definitions:

1. SO panel: stationary side lite that has the capabilities to swing away in case of emergency egress.

2. SX panel: sliding panel that has the capabilities to swing away in case of emergency egress.
3. 0 panel: stationary sidelite that does NOT have the capability to swing away.
4. Single slide: package will have one (1) stationary panel and one (1) sliding panel sliding over the stationary panel to create the clear door opening width.
5. Bi-Parting: package will have two (2) stationary panels and two (2) sliding panels sliding away from one another overlapping stationary panels to create the clear door opening width.

C. Configurations:

1. Full Breakout: Sliding and stationary sidelite panel(s) ALL swing clear for means of emergency egress.

a. Possible configurations are as follows (using definition above):

1) Single slide: SO-SO and SX-SO.
2) Bi-parting: SO-SX-SX-SO

2. Fixed sidelite: Only sliding panel swings away for emergency egress side-lite will NOT.

a. Possible configurations are as follows:

1) Single slide: 0-SX and SX-0
2) Bi-parting: 0-SX-SX-0

3. Other configurations available, please consult manufacturer.

D. Materials:

1. Framing, header, and door panels made of extruded aluminum by US supplier.

2. Mohair pile weather stripping at all vertical surfaces on door panels

2.3 ALUMINUM DOORS AND FRAMES

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and specified finish.

1. Header, frames, stiles and rails: 6063-T5
2. Extruded bars, rods, profiles and tubes: ASTM B221
3. Sheet and plate: ASTM B209

B. Framing Members: Shall be manufacturer□s standard extruded aluminum

1. 1-3/4" x 4-1/2" (44mm x 114mm), optional framing members include:

a. 1"x4-1/2"(25mmx 114mm)

b. 4-112" x 4-112" (114mm x 114mm)
c. 1-3/4" x 6" (44mm x 152mm)
d. 1" x 6-1/2"(25mmx 165mm)

2. Framing Option: Transom of size and type as indicated on drawings

C. Doors and Sidelites: Shall be 1-3/4" thick extruded aluminum stiles and rails. A minimum wall thickness of .125" is provided as standard. Stiles and rails shall be mechanically fastened with mortise and tenon blocks.

1. Stile Design: Medium stile, 3-112" (89mm):

a. Overlapping stiles shall be provided with interlocks to prevent separation of panels. Interlocks to be adjusted to maintain security when door is in the closed and locked position. Notching of interlocking stiles not acceptable.

2. Horizontal Rail Design (Muntin Bar), 1-112", optional designs include:

a. 2-1/2" (63.5mm)
b. 3" (76.2mm)
c. 3-1/2 (89mm)
d. 4" (102mm)
e. 5" (127mm)
f. 6" (152mm)

3. Bottom Rail Design: 3-1/2" (89mm), optional designs include:

a. 10" (mm)

D. Glazing Material: ANSI Z97.1

1. Doors and Sidelites: Doors and sidelites shall be capable of accepting the same thickness of glass for fixed sidelite and full break-out units.
2. Exterior Glass Stop Extrusion: Doors and sidelites shall be provided with non-removable security glass.
3. Glazing Prep: Standard glazing prep to be for 1A" glass, optional glazing prep includes:

a. 1" glazing prep
b. % glazing prep
c. 5/8" glazing prep
d. 9/16" glazing prep
e. *W* glazing prep
f. 3/8" glazing prep

E. Break-out Panels: Panels can swing out 90 degrees at any point in the slide movement to provide instant egress per NFPA 101. Required force shall to "break-out" panels shall not exceed 50 lbf (222N) applied to the lock stile. Units with break-out feature are UL Listed as an exit way.

1. Break-out door panels and break-out sidelites shall utilize an spring-load adjustable ball detent. Additional option for break-out panel:

    a. Concealed Hydraulic Closer: Standard for fixed side-lite door packages, optional for full break-out.

F. Header: Shall be 4-112" wide x 7" tall. Fabricated from extruded aluminum and extending the full width of sliding door unit between jambs. Headers shall have removable access panel for service of door operator and control.

1. Mounting: Header mounts flush with 4-112" framing
2. Capacity: Capable of supporting doors up to 200lbs per leaf spanning up to 16 -0" without intermediate supports.

G. Overhead Roller Track: Shall be continuous anodized aluminum. Track shall be replaceable.

1. Composition: Anodized aluminum, lined with rubber compound
2. Mounting: Captured within extruded channel in header
3. Isolation: Neoprene isolation member to reduce noise and vibration
4. Warranty: Lifetime

H. Overhead Rollers: Shall be manufacturer s standard carriage consisting of four *2"* rollers per leaf and two anti-rise rollers. Roller composition is manufactured from robust polymer and self-lubricating steel ball bearings.

1. Minimum number of load bearing rollers per leaf: Four (4)
2. Minimum diameter of rollers: 2"
3. Warranty: 3 years.

2.4 MOTOR GEARBOX ASSEMBLY

A. Door movement: Shall be driven by a sealed, low voltage class II, 1/8 horsepower 24v DC motor and gearbox and nylon reinforced drive belt. The motor shall have a current draw of not more than 100 watts. The sealed motor gearbox assembly shall be capable of driving door leaves of up to 225 lbs. A second motor gearbox can be utilized on the same application giving a capability of moving door panels weighing up to 450 lbs. The motor gearbox assembly shall be mounted directly to the header extrusion by means of three (3) each M5 x 1;4 threaded standoff bolts.

2.5 DOOR CARRIER ASSEMBLY AND TRACK

A. Each moving door leaf shall be supported by two door carrier assemblies, each carrier having a minimum of two supporting rollers and one adjustable "anti-riser" roller. Each supporting roller shall be 1 %" in diameter, made of nylon. Each supporting roller shall be high performance rollers with sealed bearings. The carrier assemblies shall move along a two part, replaceable track assembly. A convex aluminum extruded track allowing the door panels to travel along a horizontal plane shall be mounted on the roller track damper, which will be made of rubber. The primary purpose of the damper, being to reduce the amount of mechanical noise generated.

Track shall be warranted for the lifetime of the door.

2.6 MASTER CONTROL

A. The master control shall be capable of being programmed by either the S.M.A.R.T. panel installed as standard on all 5100 series sliding doors or by a hand held programmer. Both the S.M.A.R.T. panel and the hand held programmer will be capable of programming all swinging, sliding and folding doors within the product offering. The master control shall have only digitally adjustable parameters (for repeatability purposes, potentiometers as a method of setting parameters shall not be allowed).

B. The master control shall be a microprocessor capable of being programming, but not limited to control settings:

1. Opening and Closing speeds
2. Acceleration
3. Door open time delay
4. Remote door open time delay
5. Partial opening size
6. Reverse adjust sensitivity
7. Control of Emergency battery back up utilities
8. Fire alarm signals
9. Directional traffic flow
10. Locking
11. Remote volt free input commands.

C. The microprocessor shall also have the capability of, but not limited to:

D. Detect faults and deal with them according to method of programming including sending data to the S.M.A.R.T. panel, indicating that there is a fault, what the fault is from one of the 30 stored error screens, it will also provide a user programmed telephone contact on the display. Any updates to the software can be uploaded and updated, using the hand held programmer

2.7 MOTION AND PRESENCE SENSORS

A. The 5100 sliding door system shall include the following:

1. Combined Activation and Safety Sensor System: Shall be 24 VDC, class 11 circuits; and shall be adjusted and installed in Accordance with ANSI/BHMA A156.10. The installation shall be performed by an AAADM Certified Technician with a minimum of One (1) year in the service related field.

a. Combined Activation and Presence Sensors: The combined activation and presence sensors shall consist of active infrared or microwave technology. The sensors shall be header-mounted on each side of the door, centrally located in the opening. The sensor heads will be housed in one unit. The adjustments to the detection pattern should be completed by an AAADM certified technician in accordance with ANSI/BHMA 156.10 safety standards and compliance codes.

b. Hold-Open Beams: Two infrared photoelectric beams to be mounted in vertical rails of the sidelite or in the vertical jamb, with the photoelectric beams wired directly to the 5100 micro processor. The photo eye beams are mounted at 24" and 48" respectively above finished floor. Breaking either emitter beam will cause the door to open, remain open until the path between the emitter and diodes beams are cleared. Once cleared, the signal is reinstated and the door will close and be fully functional.

2.8 HARDWARE

A. Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated.

B. ANSI A156.5, Grade 1, 2-Point Locking provided and installed in the strike rail. Manufacturer s standard hook bolt lock operated by exterior cylinder and interior thumb turn.

1. Hook Bolt Latch: Laminated steel, latching into jamb or strike rail.
2. Two-Point Locking: Provide locking device that provide locking capability into the adjacent strike rail or jamb and extends a flush bolt into the overhead carriage assembly. Deadbolt locking options include the following:

a. Three-Point Locking for hi-parting doors
b. Lock indicators
c. Adams-Rite 4550

C. Flush Panic Exit Device, recessed in 5" muntin bar.

D. S.M.A.R.T. Panel (Self Monitoring Accurate Reporting Technology): Provide manufacturer s standard jamb mounted control panel for complete control and reporting of the automatic sliding door. Control panel capabilities include, but are not limited to the following:

1. Power On/Off
2. Full Open/Partial Open
3. Hold Open/Closed/ Automatic Operation
4. Daily Safety Check Reminder
5. Diagnostic Reporting
6. Door Cycle Count
7. Planned Maintenance Reminders

E. Weather Stripping to be along the perimeter all door panels and side-lites to reduce energy loss. Standard weather stripping includes the following:

1. Adjustable nylon sweep in the bottom of sliding door(s)
2. Double pile weather stripping on the strike rail of sliding door(s)
3. Single pile weather stripping at the following locations:

a. Between the carriage assembly and header
b. Lead stile of sidelite(s)

c. Pivot stile of sidelite(s)

2.9 ELECTRICAL REQUIREMENTS

A. The Automatic sliding door shall consume no more than 100 W of electricity at full load power.

B. Section 16 Contractor to provide 120V, 1 phase, 5 amp dedicated circuit per automatic sliding entrance

C. 120V service to be roughed into header of sliding door package.

D. Electrical rough in to be finished at time of installation

E. Optional Equipment: Building Management System:

1. Section 16 contractor will provide low voltage wiring from each automatic sliding door entrance in series with homerun to central building management center
2. Owner shall be able to access building management from site location and remote location
3. Service provider will be given dedicated remote IP address in order to assist with service to prevent unnecessary service and to ensure that if a trip is needed what problems are occurring.
4. Each door will also have its own IP address to ensure that the proper door is serviced.

2.10 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.

   a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   b. Reinforce members as required to receive fastener threads.
4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Metal Cladding: Provide metal cladding, completely cladding all visible surfaces as part of prefabricated entrance assemblies before shipment to Project site.

1. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
2. Form profiles that are sharp, straight, and free of defects or deformations.
3. Provide components with concealed fasteners and anchor and connection devices.
4. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
5. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
6. Allow for thermal expansion at exterior entrances.

E. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

F. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

G. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.
2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.
4. Provide finger guards at each pivoted entrance door that has clearance at hinge side greater than ¼ inch (6 mm) and less than ¾ inch (19 mm) with door in any position. Anchor guards to hinge-jamb frame.

H. Activation and Safety Devices:

1. General: Factory install devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:

a. TopBeam: 48 inches (1219 mm).
b. Bottom Beam: 24 inches (610 mm).

3. Install photoelectric beams in sides of guide rails, with dimension above finished floor not less than 24 inches (610 mm).

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [AAMA 2604] [AAMA 2605] and containing not less than [50] [70] percent 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.

1. Color and Gloss: See Color Schedule in drawings.

PART 3- EXECUTION

3.1 INSPECTION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Inspect frame opening for correct size, plumb and square and level floor for safe and reliable performance. Provide written notification to the appropriate personnel of conditions not

acceptable to the installer and/or manufacturer.

C. Proceed with installation only after necessary corrections are made by the general contractor to insure a suitable opening ..

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints. Seal joints watertight.

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using non-shrink grout.
5. Provide thresholds at exterior doors and where indicated.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 16 Sections.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Division 16 Sections.

E. Activation and Safety Devices: Install and adjust devices to provide detection field and functions indicated.

F. Guide Rails: Install rails according to BHMA A156.10 including Appendix A and manufacturer s written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Division 8 Section "Glazing."

H. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants" to provide weathertight installation.

1. Set thresholds, framing members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelight as required by referenced door standards.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer s written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

A. Inspection: Owner will engage a certified inspector to test and inspect automatic entrances and prepare test and inspection reports.

1. Certified inspector shall test and inspect each automatic entrance to determine compliance of installed systems with applicable BHMA standards.
2. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.

B. Work will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in [BHMA A156.10] [and] [BHMA Al56.19].

B. Lubricate operating hardware and other moving parts as recommended by manufacturer.

C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING AND PROTECTION

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Division 8 Section "[Glazing] [Security Glazing]" for cleaning and maintaining glass.

3.6 INSTRUCTION

A. Following the installation and final adjustments, the installer shall fully instruct the facility manager as to correct operating procedure and safety requirements of the sliding door package.

B. Engage a certified inspector to train Owner s maintenance personnel to adjust, operate, and maintain automatic entrances.

3.7 FINAL CLEANUP

A. After installation and adjustment for smooth, reliable operation, clean the door package and remove all surplus material, equipment, and debris incidental to this work.

END OF SECTION 08 4600

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SECTION 08 6200 - UNIT SKYLIGHTS

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. Self-flashing unit skylights with integral curbs.
2. Unit skylights mounted on prefabricated curbs.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of unit skylight.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for unit skylights.
2. Motors: Show nameplate data, power requirements, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For unit skylight work.

1. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

C. Aluminum Finish Samples: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer s standard size.

D. Glazing Samples: For each color and finish of glazing indicated, 12 inches square and of same thickness indicated for the final Work.

E. Product Schedule: For unit skylights. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Product Test Reports: For each type and size of unit skylight, for tests performed within the last four years by a qualified testing agency. Test results based on testing of smaller unit skylights than specified will not be accepted.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For unit skylights to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of units required for this Project.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Uncontrolled water leakage.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Yellowing of acrylic glazing.
d. Breakage of polycarbonate glazing.
e. Deterioration of insulating-glass hermetic seal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Sunoptics Prismatic Skylights – 801-535-4345.

2.2 PERFORMANCE REQUIREMENTS

A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Performance Class and Grade: Class CW-PG 30.
   2. Certification: AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.

B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.82 Btu/sq. ft. x h x deg F.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 0.52.

2.3 UNIT SKYLIGHTS

A. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.

B. Unit Shape and Size: As indicated.

C. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

   1. Double-Glazing Profile: Pyramid, 30-degree slope.

      a. Thicknesses: Not less than thicknesses required to exceed performance requirements.
      b. Outer Glazing Color: Colorless, transparent.
      c. Inner Glazing Color: White, translucent.

   2. Self-Ignition Temperature: 650 deg F or more for plastic sheets in thickness indicated when tested according to ASTM D 1929.
   3. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested according to ASTM E 84, and smoke density of 75 or less when tested according to ASTM D 2843
   4. Burning Characteristics: Tested according to ASTM D 635. Class CC2, burning rate of 2-1/2 inches per minute or less for nominal thickness of 0.060 inch or thickness indicated for use.

D. Glazing Gaskets: Manufacturer's standard.

E. Integral Curb: Extruded-aluminum, self-flashing type.

   1. Extruded-Aluminum Shapes: ASTM B 221, alloy and temper to suit structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.
   2. Height: As indicated.
   3. Construction: Single wall.
   4. Insulation: Manufacturer's standard rigid or semirigid type.

      a. Exposed Insulation: Cover face of insulation exposed to interior of building with aluminum liner.

F. Prefabricated Curb: As specified in Section 07 7200 "Roof Accessories."

G. Condensation Control: Fabricate unit skylights with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.

H. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.

I. Protective Screens: Rated to minimum of 200lbs.

2.4 ACCESSORY MATERIALS

A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.

1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

2.5 ALUMINUM FINISHES

A. Mill Finish: Manufacturer s standard.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: As selected by Architect from full range of industry colors and color densities.

2. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer s written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer s full range.

E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent 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.

1. Color and Gloss: As selected by Architect from manufacturer s full range.

F. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating

and resin manufacturers written instructions.

1. Color and Gloss: As selected by Architect from manufacturer s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer s written instructions for installing unit skylights.

C. Install unit skylights level, plumb, and true to line, without distortion.

D. Anchor unit skylights securely to supporting substrates.

E. Where aluminum surfaces of unit skylights will contact another metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by unit skylight manufacturer.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.

C. Perform test for total area of each unit skylight.

D. Work will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspections, at Contractor s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.4 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

E. Unit Skylight Operating System: Clean and lubricate joints and hardware. Adjust for proper operation.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain unit skylight operating system.

END OF SECTION 08 6200

SECTION 08 7100 - FINISH HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division -1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Definition: "Finish Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and no-matching hardware specified in the same section as the door and door frame.

B. Extent of finish hardware required is indicated on drawings and in schedules. Types of finish hardware required include the following:
   1. Hinges
   2. Lock cylinders and keys Exit devices
   3. Closers
   4. Smoke Seal Gaskets
   5. Astragals or meeting seals on pairs of doors Thresholds

C. Silencers included integral with hollow metal frames are specified with door frames elsewhere in Division 8.

D. Weather stripping included integral with hollow metal frames are specified with door frames elsewhere in Division 8.

1.2 QUALITY ASSURANCE:

A. Manufacturer: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the project s vicinity for a period of not less than 2 years, and who is, or who employs a full time experienced architectural hardware consultant (AHC) who is available, at reasonable times during the course of the work, for consultation about project s hardware requirements, to Owner, Architect and Contractor.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturers technical product data for each item of hardware in accordance with Division-1 section "Submittals". Include whatever information may be necessary to show compliance with requirements and include instructions for installation and for maintenance of operating parts and finishes.

B. Hardware Schedule: Submit final hardware schedule in manner indicated below. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand, function and finish of hardware.

1. Final Hardware Schedule Content:
    a. Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
        i. Type, style, function, size and finish of each hardware item. Name and manufacturer of each item.
        ii. Fastenings and other pertinent information.
        iii. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
        iv. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
        v. Mounting locations for hardware.
        vi. Door and frame sizes and materials.
        vii. Keying information.
2. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.
3. Samples: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.
    a. 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.
4. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.
5. Fire- Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.4 PRODUCT HANDLING:

A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packaged in same container.

C. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

E. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

PART 2- PRODUCTS

2.1 SCHEDULED HARDWARE:

A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Finish Hardware Data Sheet and Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer□Product Designations: One or more manufacturers are listed for each hardware type required. An Asterisk (*) after a manufacturer□name indicates whose product designation is used in the Hardware Schedule for purposes of establishing minimum requirements. Provide either the product designated, or, where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in this section.

2. ANSI *I* BHMA designations used elsewhere in this section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this section.
   a. Butts and Hinges: ANSI A156.1 (BHMA 101)
   b. Locks and Lock Trim: ANSI A156.2 (BHMA 601)
   c. Exit Devices: ANSI A156.3 (BHMA 701)
   d. Door Controls - Closers: ANSI A156.4 (BHMA 301)
   e. Auxiliary Locks: ANSI A156.5 (BHMA 501) Architectural Door
   f. Trim: ANSI A156.6 (BHMA 1001)
   g. Template Hinge Dimensions: ANSI A156.7
   h. Materials & Finishes: ANSI A156.18 (BHMA 1301)

2.2 MATERIALS AND FABRICATION:

A. General:
1. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer s Name Plate: Do not use manufacturer s products which have manufacturer s name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Architect. Manufacturer s identification will be permitted on rim of lock cylinders only.
3. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer s standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicted, except as otherwise specified.
4. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
5. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.
7. Tools and Maintenance Instruction for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner s continued adjustment, maintenance, and removal and replacement of finish hardware.

2.3 HINGES, BUTTS AND PIVOTS:

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

B. Screws: Furnish Phillips flat-head or machine screws for installation of units, except furnish Phillips flat-head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
1. Steel Hinges: Steel pins.
a. Non- ferrous Hinges: Stainless steel pins.
b. Exterior Doors: Non-removable pins

D. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.

E. Number of hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.

2.4 LOCK CYLINDERS AND KEYING:

A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.

B. Standard System: Except as otherwise indicated, provide new master key system for project.

C. Equip locks with SFIC (Small Format Interchangeable Core), 7-pin cylinders.

D. Metals: Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.

E. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

F. Permanently inscribe each key with number or lock that identifies cylinder manufacturer key symbol, and notation "DO NOT DUPLICATE."

G. Key Material: Provide keys of nickel silver only.

H. Key Quantity: Furnish 3 keys of each type;

1. Grand Master Keys: This key shall open all door cylinders.
2. Master Keys: This key shall open all door cylinders except the office.

I. Furnish one extra blank for each lock.

J. Deliver keys to Owner's representative.

K. Special Note: All exterior doors and all doors with Exit Devices (whether exterior or interior) shall be equipped with key interchangeable core cylinders. Hardware Supplier shall furnish a temporary set of cores for use during construction. At the completion of the project this temporary set shall be returned to the Hardware Supplier for full credit and the permanent cores installed. Hardware Supplier shall furnish one additional set of cores for future use of the Owner if the need arises to re-secure the building quickly. Furnish 3 Control Keys.

2.5 LOCKS, LATCHES AND BOLTS:

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

B. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

C. Provide roller type strikes where recommended by manufacturer of the latch and lock units.

D. Lock Throw: Provide 5/8" minimum throw of latch and deadbolt used on pairs of

doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings. Provide *W* minimum throw on other latch and deadlock bolts.

E. Flush Bolt Heads: Minimum of *Yz"* diameter rods of brass, bronze or stainless steel, with minimum 12" long rod for doors up to 7 0" in height. Provide longer rods as necessary for doors exceeding 7 0" in height.

F. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with key dogging device to hold the push bar down and the latch bolt in open position.

G. Rabbeted Doors: Where rabbeted door stiles are indicted, provide special rabbeted front on lock and latch units and bolts.

H. Note: All locksets shall be commercial quality and meet ADA requirements.

2.6 CLOSERS AND DOOR CONTROL DEVICES:

A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer s recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

B. Where parallel arms are indicted for closers, provide closer unit one size larger than recommended for use with standard arms.

2.7 HARDWARE FINISHES:

A. Provide matching finishes for hardware units at each door opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer s standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer s standards, but in no case less than specified for the applicable units of hardware by referenced standards.

C. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "No Lacquer."

D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI A156.18 "Materials & Finishes Standard", including coordination with the traditional U. S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may by otherwise directed by Architect.

B. Install each hardware item in compliance with the manufacturer s instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

3.2 ADJUST AND CLEAN:

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surface soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner s Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner s personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.3 HARDWARE SCHEDULE

A. Hardware finish and base metal: Satin Stainless steel

B. Pulls:
   1. 3" etc. brushed nickel handles on service doors and drawers only. No handle on customer accessible doors but cabinet doors will lip down *W*

on bottoms to allow easy employee access.

C. Hinges:
   1. Salice 165-degree hinge (C27FA99 full overlay, self-close) with face frame plate (3 screws) all doors over 19" tall will receive 3 hinges.

D. Drawer guides:
   1. 100 lb., full extension, ball bearing drawer slides.

E. Shelving clips:
   1. 5mm clips for vertical holes at 32 mm (1 14") on center.

3.4 DOOR HARDWARE SCHEDULE:

Group 1	1 Set	Cylinders	As Required by Door Manufacturer		
Group 2			All Hardware by Door Manufacturer		
Group 3	1.5 Pair	Butts	BB5000 4.5 x 4.5		
	1 Each	Lockset	DL2700		Trilogy
	1 Each	Closer	DC300		Arrow
	1 Each	Stop	FS13	630	Ives
	3 Each	Silencer			
	1 Each	Kick Plate	12” x 34”	630	Ives
Group 4	1.5 Pair	Butts	BB5000 4.5 x 4.5	26D	Bommer
	1 Each	Lockset	DL2700		Trilogy
	1 Each	Closer	DC300		Arrow
	1 Each	Stop	WS407-CCV	630	Ives
	3 Each	Silencer			
	1 Each	Kick Plate	12” x 34”	630	Ives
Group 5	1.5 Pair	Butts	BB5000 4.5 x 4.5 NRP	26D	Bommer
	1 Each	Exit	98L ALK Alarm	26D	Von Duprin
	1 Each	Threshold	425		NG
	1 Each	Closer	4040XP		LCN
	1 Each	Weather-strip	160		NG
	1 Each	Sweep	200		NG
	1 Each	Kick down Holder	FS555	626	Ives
	1 Each	Floor Stop	FS444	626	Ives
	1 Each	Kick Plate	30” x 46”	630	Ives
	1 Each	Door Viewer	700	630	Ives
Group 6	1.5 Pair	Butts	BB5000 4.5 x 4.5	26D	Bommer
	1 Each	Push Plate	8200 6” x 16”	630	Ives
	1 Each	Pull Plate	8302-1 4” x 16”	630	Ives
	1 Each	Closer	4040XP		LCN
	1 Each	Stop	WS407-CCV	630	Ives
	3 Each	Silencer			

	1 Each	Kick Plate	12” x 34”	630	Ives
Group 7	1.5 Pair	Butts	BB5000 4.5 x 4.5 NRP	26D	Bommer
	1 Each	Exit	98L ALK Alarm	26D	Von Duprin
	1 Each	Kick Plate	30” x 46”	630	Ives
	1 Each	Threshold	425		NG
	1 Each	Weather-strip	160		NG
	1 Each	Closer	4040XP		LCN
	1 Each	Sweep	200		NG
Group 8	1.5 Pair	Butts	BB5000 4.5 x 4.5 NRP	26D	Bommer
	1 Each	Lockset	ND53PD RHO	626	Schlage
	1 Each	Exit	98L ALK Alarm	26D	Von Duprin
	1 Each	Threshold	425		NG
	1 Each	Weather-strip	160		NG
	1 Each	Closer	4040XP		LCN
	1 Each	Sweep	200		NG

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MAVERIK - HARDIN
1199 HIGHWAY 47
HARDIN, MT

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for windows doors interior borrowed Lites storefront framing glazed curtain walls.
2. Glazing sealants and accessories.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 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 square.

1. Coated glass.
2. Insulating glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. 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.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of insulating-glass units with sputter-coated, low-E coatings glass testing agency and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For coated glass insulating glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 08 4113 "Aluminum-Framed Entrances

and Storefronts" to match glazing systems required for Project, including glazing methods.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 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.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.12 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AGC Glass Company North America, Inc.
2. Guardian Industries Corp.; SunGuard.
3. PPG Industries, Inc.
4. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   a. Wind Design Data: As indicated on Drawings.
   b. Importance Factor: 1.0.
   c. Exposure Category: B.
3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located more than 30 feet above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. 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. For monolithic glass lites, properties are based on units with lites 6 mm thick.
2. For laminated glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. 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.
5. 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.
6. 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 indicated, 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.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength:

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. 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.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

B. 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.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."

D. Reflective-Coated Vision Glass: ASTM C 1376.

E. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, 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 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 seal, with polyisobutylene and polysulfide primary and secondary sealants.
2. Spacer: Polypropylene-covered stainless steel in color selected by Architect.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

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. 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 100/50, Use NT.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining 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. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

    a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges

with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. 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.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

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.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. 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. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. 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.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 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.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type: Clear heat-strengthened float glass.

1. Minimum Thickness: 6 mm.

B. Glass Type Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.

3.9 LAMINATED GLASS SCHEDULE

A. Glass Type: Clear laminated glass with two plies of **heat-strengthened** float glass.

1. Basis-of-Design Product: **XIR Laminated 72-47 Clear Low-e Glazing system**.
2. Minimum Thickness of Each Glass Ply: 3 mm.
3. Maverik Country Stores has developed national pricing account with the following dealers:
   a. Glass Pro, 800-776-2368
   a. Cristacurva, 866-229-0906, sales@cristacurva.com
4. Exception: Do NOT use this glazing if facing North, Verify with Architect.
5. U-Value: 0.29
6. SHGC: 0.33
7. Glazing equal to Solarban 60 ratings.

B. Glass Type: Clear laminated glass with two plies of **fully tempered** float glass.

1. Basis-of-Design Product: **XIR Laminated 72-47 Clear Low-e Glazing system**.
2. Minimum Thickness of Each Glass Ply: 3 mm.
3. Maverik Country Stores has developed national pricing account with the following dealers:
   a. Glass Pro, 800-776-2368
   b. Cristacurva, 866-229-0906, sales@cristacurva.com
4. Exception: Do NOT use this glazing if facing North, Verify with Architect.
5. U-Value: 0.29
6. SHGC: 0.33
7. Glazing equal to Solarban 60 ratings.

3.10 INSULATING GLASS SCHEDULE

A. Glass Type: Clear insulating glass.

1. Basis-of-Design Product: **AFG&LOF**.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass.
7. Winter Nighttime U-Factor:.5 maximum.
8. Summer Daytime U-Factor:.5 maximum.

9. Safety glazing required.
10. SHGC: .27

B. Glass Type: Clear insulating glass.

1. Basis-of-Design Product: **PPG Solarban 70XL**.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass.
7. Winter Nighttime U-Factor:.28 maximum.
8. Summer Daytime U-Factor:.26 maximum.
9. Safety glazing required.
10. SHGC: .27

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SECTION 09 2216 - NON-STRUCTURAL METAL 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:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

B. Related Requirements:

1. Section 05 4000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members certification is according to SIFA "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For steel studs and runners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to

ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) CEMCO; California Expanded Metal Products Co.
      2) Steel Network, Inc. (The).
   b. Minimum Base-Metal Thickness: 0.0296 inch.
   c. Depth: As indicated on Drawings.

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. CEMCO; California Expanded Metal Products Co.
   b. Clark Dietrich Building Systems.
   c. Fire Trak Corp.
   d. Steel Network, Inc. (The).

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Clark Dietrich Building Systems.
   b. MRI Steel Framing, LLC.
2. Minimum Base-Metal Thickness: 0.0296 inch.

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Clark Dietrich Building Systems.

b. MRI Steel Framing, LLC.

2. Depth: As indicated on Drawings.

3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Clark Dietrich Building Systems.
   b. MRI Steel Framing, LLC.

2. Minimum Base-Metal Thickness: 0.0296 inch.

3. Depth: As indicated on Drawings.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

1. Depth: 2 inches.

D. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.
   a. Minimum Base-Metal Thickness: 0.0296 inch.
   b. Depth: As indicated on Drawings.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Armstrong World Industries, Inc.
   b. United States Gypsum Company.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 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.

3.4 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.

1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.

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 that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. 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.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment,

or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 2100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 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.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

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, counters playing, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2216

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SECTION 09 2900 - GYPSUM BOARD

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. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
3. Section 09 3100 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer s standard size for each textured finish indicated and on same backing indicated for Work.

C. Samples for Initial Selection: For each type of trim accessory indicated.

D. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer s standard size for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer s written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Core: 5/8-inch, Type X.

2.5 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.
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (control) joint.

2.6 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 setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sand able topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sand able topping compound.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer s written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Ceiling Type: Ceiling surfaces.

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 vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches 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-shaped 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 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

A. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. 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.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove 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.

1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3100- CERAMIC TILE

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Ceramic mosaic tile.
2. Paver tile.
3. Glazed wall tile.
4. Crack suppression membrane for thin-set tile installations.
5. Stone thresholds installed as part of tile installations.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Division 9 Section "Gypsum Board Assemblies" for water resistant GYD. BRO. installed in gypsum wallboard assemblies.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.

B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:

1. Heavy: Passes cycles 1 through 12.

1.5 SUBMITTALS

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Tile Samples for Initial Selection: Manufacturer s color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

C. Grout Samples for Initial Selection: Manufacturer s color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

D. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

E. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

1. Stone thresholds.
2. Joint sealants.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer s written instructions.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated on the drawing.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for

Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.

2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Match Architect's samples.

2. Match colors, textures, and patterns indicated by referencing manufacturer's standard designations for these characteristics.

3. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

A. Unglazed Paver Tile: Provide flat tile complying with the following requirements:

1. Composition: Porcelain.

2. Facial Dimensions: 6 by 36.

3. Thickness: 1/4 (6.35 mm).

4. Face: Plain with cushion edges.

B. Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 4-1/4 x 9-1/4.

2. Thickness: (8 mm).

3. Face: Pattern of design indicated, with manufacturer's standard edges, matte finish.

4. Mounting: Factory back mounted.

C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply

with the following requirements:

I. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.

a. Base for Thin-Set Mortar Installations: Straight.

b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.

c. External Corners for. Thin-Set Mortar Installations: Surface bullnose.

d. Internal Corners: Field-butted square corners, except with caved base and cap angle pieces designed to member with stretcher shapes.

D. Crack-suppression Membranes for Thin-Set Tile Installations: Manufacturer s standard product that complies with ANSI A118.10, selected from the following.

1. Fabric-Reinforced, Modified-Bituminous Sheet Product: SBS-modified-bituminous sheet with woven reinforcement facing, 0.040-inch (1.01 mm) nominal thickness.

a. Basis of design: Mapei: Mapeguard 2 – ANSI A118.2 for crack isolation.

b. Available Products:

1.) National Applied Construction Products, Inc.; Strataflex
2.) Laticrete International Inc; crack isolation membrane.
3.) Manufacturers recommended primer and adhesive.

2.4 STONE THRESHOLDS

A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces where shown.

1. Fabricate thresholds to heights indicated, but not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.

B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241 where shown.

1. Provide white, honed marble complying with the Marble Institute of America s Group A requirements for soundness.

C. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:

a. Basis of design – Mapei Ultraflex LFT: ANSI A118.4TE – ISO C2TES1P1

b. Latex Additive: Acrylic resin.

c. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

2.5 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI All8.6 for materials described in Section H-2.4, composed as follows:

I. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:

a. Un-sanded Dry-Grout Mix: Dry-set grout complying with ANSI A118.6 for materials described in Section H-2.3, for joints l/8 inch (3.2 mm) and narrower.

b. Sanded Dry-Grout Mix: Commercial Portland cement grout complying with ANSI A 118.6 for materials described in Section H-2.1, for joints 1/8 inch (3 .2 mm) and wider.

c. Latex Additive: Actylic resin.

2.6 ELASTOMERIC SEALANTS

A. General: Provide manufacturer s standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

A. Trowel able Underlayment's and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 F (49 to 60 deg C) per ASTM D 87.

2. Grout release in form of manufacturer s standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout

manufacturers.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers written instructions.
Add materials, water, and additives in accurate proportions.
Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors installed with dry-set or latex-Portland cement mortars that comply with flatness tolerances specified in referenced ANSI A 108 series of tile installation standards for installations indicated.

1. Use trowel able leveling and patching compounds per tile-setting material manufacturer s written instructions to fill cracks, holes, and depressions.

2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from

one package show the same range in colors as those taken from other packages and match approved Samples. If not, factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:

1. Petroleum paraffin wax applied hot.

2. Grout release.

3. Petroleum paraffin wax or grout release.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

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 grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

E. Lay out tile wainscots to next full tile beyond dimensions indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

G. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-Portland cement, dry-set, commercial Portland cement, and latex-Portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Large Format Floor Tile: 3/16 inch.
2. Quarry floor Tile: Per manufacturer's recommendations.

C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A 108 series of tile installation standards:

1. Tile floors composed of tiles 8 by 8 (203 by 203 mm) or larger.
2. Tile floors composed of rib-backed tiles.

D. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

E. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, or other flooring that finishes flush with top of tile.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Large Format Wall Tile: 3/16 inch.
2. Glazed Wall Tile: 1/8 inch.

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-Portland cement grout residue from tile as soon as possible.

2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it

from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unhanded, and otherwise defective tile work.
C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting 1s completed. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 CERAMIC TILE FLOOR INSTALLATION SCHEDULE

A. Porcelain Ceramic Tile Floor Installation: Where interior floor installations of this designation are indicated, comply with the following:

1. Tile Type: Unglazed paver tile. Provide one of the following products:

a. Refer to Construction Drawings

2. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:

a. Latex-Portland cement mortar.
b. Sanded latex-Portland cement grout.
c. See construction drawings for color

3.8 CERAMIC TILE WALL INSTALLATION SCHEDULE

A. Ceramic Tile Wall Installation: Where wall installations of this designation are indicated, comply with the following:

1. Tile Type: Glazed wall tile. Provide one of the following products:

a. As shown on construction drawings

2. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
a. Latex-Portland cement mortar.
b. See construction drawings for color.

END OF SECTION 09 3100

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

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. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
3. Clips: Full-size hold-down impact and seismic clips.

E. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.

2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Mockups: 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 ceiling area 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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. 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: Class A according to ASTM E 1264.

2. Smoke-Developed Index: 50 or less.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. USG Corporation.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Color: White, Vinyl

D. Edge/Joint Detail: Square.

E. Modular Size: As indicated on Drawings.

F. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Post-installed expansion anchors.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

C. Hold-Down Clips: Manufacturer's standard hold-down.

D. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

E. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. 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 unless otherwise indicated and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer s written instructions.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two post-installed anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements,

testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113

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SECTION 09 6510 - RESILIENT FLOOR TILE

PART **1**- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Rubber floor tile.

B. Related Sections:

1. Division 9 Section "Resilient Wall Base and Accessories" for resilient base, reducer.

1.3 SUBMITTALS

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

B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

C. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer.

B. Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than

65 F or more than 85 deg F, 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. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 For more than 85 F.

C. Close spaces to traffic during floor tile installation.

D. Install floor tile after other finishing operations, including painting, have been completed.

1. 7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for evety 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2- PRODUCTS

2.1 RUBBER FLOOR TILE

A. Products: Subject to compliance with requirements, provide one of the following (refer to color schedule also):

1. Dinoflex

2. Roppe Corporation, USA;

B. Thickness: 3/8".

C. Seaming Method: Interlocking

D. Colors and Patterns: Refer to Color Schedule.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpatt D (EPA Method 24):

a. Rubber Floor Tile Adhesives: Not more than 60 g/L.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

PREPARATION

A. Prepare substrates according to manufacturer s written instructions to ensure adhesion of resilient products.

B. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

C. Fill cracks, holes, and depressions in substrates with trowel able leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 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.

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, non-staining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor 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 flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. All seams must be fitted tightly together and held immediately with Painter's Tape for a minimum of 24 hours after the installation has been completed while the adhesive cures.

1. DO NOT use duct tape or other tapes with tacky residues that will be either difficult or impossible to remove.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 6510

SECTION 09 9113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on exterior substrates.

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Steel.
5. Mechanical Equipment.
6. Aluminum (not anodized or otherwise coated).
7. Stainless-steel flashing.
8. Wood.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. 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 specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
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.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer s original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacture's label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; 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 Sherwin-Williams Company products indicated or comparable product from one of the following:

1. Benjamin Moore & Co.
2. Kwal, Division of Sherwin-Williams.
3. PPG Architectural Finishes, Inc.

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer s designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by

manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings Foot Traffic: 100 g/L.
9. Floor Coatings High Performance: 250 g/L.
10. Shellacs, Clear: 730 g/L.
11. Shellacs, Pigmented: 550 g/L.
12. Wood Coatings: 275 g/L

2.3 WOOD STAIN – See Schedule.

2.4 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Wood: 15 percent.
d. Portland Cement Plaster: 12 percent.
e. Gypsum Board: 12 percent.

2. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
3. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer s written instructions and recommendations in "MPI Manual" applicable to substrates and paint 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.

C. Clean substrates of substances that could impair bond of paints, 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 paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer s written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer s written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Rooftop Mechanical Equipment: Remove grease and oil residue from rooftop equipment metal to produce a clean surface that promotes adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer s written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Rooftop HVAC and condensing units
i. Metal cap of rooftop equipment curbs
j. Exposed portions of pipes, vents and flues that are adjacent to PVC roofing

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Clay Masonry Cementitious Siding, Nontraffic Surfaces:

1. Latex System:

a. Prime Coat: Primer sealer, latex, exterior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
b. Prime Coat: Latex, exterior, matching topcoat.
c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0

mils wet, 1.2 mils dry, per coat.

e. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
f. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
g. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
h. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

B. Concrete Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Paint System:

a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

C. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
d. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
e. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
f. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
g. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

D. Ferrous Metal and Aluminum Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, water-based, anti-corrosive for metal: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
b. Prime Coat: Shop primer specified in Section where substrate is specified.
c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
d. Topcoat: Light industrial coating, exterior, water based, eggshell: S-W Pro Industrial Eg-Shel Acrylic B66-660 Series, at 2.5 to 4.0 mils dry, per coat.
e. Topcoat: Light industrial coating, exterior, water based, semi-gloss: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
f. Topcoat: Light industrial coating, exterior, water based, gloss: S-W Pro Industrial

Acrylic Gloss Coating, B66-600 Series, at 2.5 to 4.0 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer, latex for exterior wood.
a. Intermediate Coat: Latex, exterior, matching topcoat.
b. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
c. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
d. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
e. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
f. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

F. Wood Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Paint System:

a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

END OF SECTION 09 9113

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SECTION 09 9123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
2. Section 09 9113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. 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 specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
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.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer s original sealed containers, complete with labels and instructions for handling,

storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; 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 Sherwin-Williams Company products indicated or comparable product from one of the following:

1. Benjamin Moore & Co.
2. Kwal, Division of Sherwin-Williams.
3. PPG Architectural Finishes, Inc.

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services□"Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings Foot Traffic: 100 g/L.
9. Floor Coatings High Performance: 250 g/L.
10. Shellacs, Clear: 730 g/L.
11. Shellacs, Pigmented: 550 g/L.
12. Wood Coatings: 275 g/L.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove

noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Wood: 15 percent.
d. Gypsum Board: 12 percent.
e. Plaster: 12 percent.

2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
3. Plaster Substrates: Verify that plaster is fully cured.
4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates 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 paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or another paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or another paintable jacket material.
h. Grills, louvers and vents
i. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

   a. Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
   d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
   e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
   f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
   g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

B. Concrete Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Enamel System:

   a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.

b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

C. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal.
b. Intermediate Coat: Latex, interior, matching topcoat.
a. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
b. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
c. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
d. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
e. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
3. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."

D. Metal Substrates (Aluminum, Steel, Galvanized Steel):

1. Latex System:

a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
c. Topcoat: Water-based acrylic, semi-gloss: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
d. Topcoat: Water-based acrylic, gloss: S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
d. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
e. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Varnish Clear Finish System:

    a. Prime Coat: Primer sealer, latex, interior: S-W WoodClassics or Minwax 250 Oil Stain, (Optional).
    b. Intermediate Coat: Clear WaterBased, matching topcoat.
    c. Topcoat: Latex, interior, Satin: S-W Minwax Waterborne Polyurethane Varnish, at 4.0 mils wet, 1.0 mils dry, per coat.
    d. Topcoat: Latex, interior, semi-gloss: S-W Minwax Waterborne Polyurethane Varnish, at 4.0 mils wet, 1.0 mils dry, per coat.
    e. Topcoat: Latex, interior, gloss: S-W Minwax Waterborne Polyurethane Varnish, at 4.0 mils wet, 1.0 mils dry, per coat

F. Wood Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Enamel System:

    a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
    b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

G. Gypsum Board Substrates:

1. Latex System:

    a. Prime Coat: Primer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
    d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
    e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
    f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
    g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

END OF SECTION 09 9123

SECTION 10 1550 - TOILET COMPARTMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid-polymer units as follows:

1. Toilet Enclosures: Floor, ceiling and wall anchored.
2. Urinal Screens: Floor anchored, and Wall anchored, and Ceiling anchored.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for blocking and overhead support of floor and- ceiling-anchored units.
2. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
Samples for Initial Selection: For each type of unit indicated.

1.4 QUALITY ASSURANCE

A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2- PRODUCTS

2.1 SOLID COLOR REINFORCED COMPOSITE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bobrick – Basis of Design; SierraSeries 1090

B. Door, Panel, and Pilaster Construction: Solid Color Reinforced Composite SierraSeries 1090 panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material. All panels and doors shall be 55" high.

1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer s full range of colors and patterns.

C. Stainless Steel Shoes and Sleeves (Caps): Manufacturer s standard design; Floor to ceiling.

D. Brackets (Fittings):

1. Continuous Stainless-Steel wall brackets.

2.2 ACCESSORlES

A. Hardware and Accessories: Manufacturer s standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless Steel.

B. Anchorages and Fasteners: Manufacturer s standard exposed fasteners of stainless steel with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Floor-and-Ceiling-Anchored Units: Provide manufacturer s standard corrosion-resistant anchoring assemblies complete with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (9 1 4-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer□s standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer□s standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer□s standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer□s standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer□s standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

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. Panels: 1/2 inch.
   b. Doors: 3/4 inch.
   c. Sills: 3/4 inch

2. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position. Doors shall be mounted 14" A.F.F.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer□s written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

3.3 WARRANTY

A. Manufacture guarantees its plastic against breakage, corrosion, and delamination under normal

conditions for 15 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. (Labor not included in warranty.)

END OF SECTION 10155

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless Corner guards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long. Include example top caps.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of handrail.

B. Material Certificates: For each type of exposed plastic material.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include

precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- long units.
2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; 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: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Floor Products Company, Inc.
   b. Babcock-Davis.
   c. Balco, Inc.
   d. JL Industries, Inc.; a division of the Activar Construction Products Group.

2. Material: Stainless-steel sheet, Type 304.

   a. Thickness: Minimum 16 ga.
   b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Adhered to wall – no visible fasteners.

2.4 MATERIALS

A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

B. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other

imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer□s written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 2600

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SECTION 10 5200- FIRE-PROTECTION SPECIALTIES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection accessories.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Portable Fire Extinguishers:
   a. Badger; Div. of Figgie Fire Protection Systems.
   b. Buckeye Fire Equipment Company.
   c. J.L. Industries, Inc.
   d. Kidde: Walter Kidde, The Fire Extinguisher Co.
   e. Larsen s Manufacturing Company.

2. Fire-Protection Cabinets:
   a. J.L. Industries, Inc.
   b. Larsen s Manufacturing Company.
   c. Moon/ American, Inc.

2.2 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 2-A:lO:B:C, 5-lb (2.3-kg) nominal capacity, m enameled-steel container.

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 baked-enamel finish.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer s written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fasten mounting brackets square and plumb.

END OF SECTION 10 5200

SECTION 10 8010 -TOILET AND BATH ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Infant-care products.
3. Under-lavatory guards.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and tun concmrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer s Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet and Bath Accessories:
   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.

2. Under lavatory Guards:
   a. Brocar Products, Inc.
   b. Tmebro, Inc.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.03 minimum nominal thickness, unless otherwise indicated.
(0.8-mm)

B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

FABRICATION

A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Provide concealed anchorage where possible.

C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper resistant glass installation and prevents moisture accumulation.

D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3- EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units' level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE - SEE PLANS

END OF SECTION 10 8010

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SECTION 12 2413 - ROLLER WINDOW SHADES

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. Motor-operated roller shades with single rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 9200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ALLOWANCES

A. Roller shades are part of Window-Covering Allowance.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shade band materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shade band material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

F. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shade band material.

C. Product Test Reports: For each type of shade band material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.7 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shade band material indicated, but no fewer than two units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

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. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.10 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.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Mariak Contract.

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

a. Electrical Characteristics: 110-V ac.
b. Maximum Total Shade Width: As required to operate roller shades indicated.
c. Maximum Shade Drop: As required to operate roller shades indicated.
d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Confirm with Owners Representative: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

a. Individual/Group Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.

b. Color: As selected by Architect from manufacturer's full range.

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

C. Rollers: Confirm with Owners Representative: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade bands for service.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shade band material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shade band assembly when shade is fully open, but not less than 4 inches.
2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shade band 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: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer – with options selected by Owner.
2. Type: Selected by Owner.
3. Weave: Selected by Owner.
4. Thickness: Selected by Owner.
5. Weight: Selected by Owner.
6. Roll Width: Selected by Owner.
7. Orientation on Shadeband: Selected by Owner.

8. Openness Factor: Selected by Owner - percent.
9. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

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. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer s written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner s maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 2413

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MAV-SI: 23_01

Issue Date: 5/12/2023

***The following clarifications/corrections will be applied to all projects in 2023 and beyond. Please note if construction of the project has started the Maverik Project Manager is to determine if the below information is to be added to the project and will direct the Architect/Engineer as to what is to be implemented.*

Prototype Updates

Description

1. Fuel Systems
   A. See attached "Specifications Section 13 Update Narrative" (attached) for insructions on updating Section 13 of the specifications and included forms.

   B. Veeder Root programming and set-up should be per the following guidelines:
      a. Non-California sites: Utilize the attached programming guide.
      b. California sites: Directed by a California certified Veeder Root installer.

   C. All Projects:
      Fuel Dispensing Drawings are to provide information shown on attached document "Maverik Fuel Tank Fill & Vapor Markings".

Attachments

- Specifications Section 13 update Narrative
- Maverik ATG Setup Standards for TLS-450Plus for Non-CA Stores (for Vendor Use)
- Maverik Fuel Tank Fill & Vapor Markings

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Specifications Section 13 update Narrative

1. Please discontinue the use of specification division 13 and replace with the practices described below:
    a. PRE-INSTALLATION: Tank Integrity Testing - Use the pre-installation testing protocol in the following references:
        i. Containment Solutions Fiberglass Tank Installation Instructions & Operating Guidelines (Version J05/15 or most recent)
        ii. Section 4. Pre-Installation Testing (attached)
        iii. Xerxes Installation Manual and Operating Guidelines (most recent version)
        iv. Section 3. Preinstallation Inspection and Testing (attached)
    b. DURING INSTALLATION:
        i. Piping Integrity Testing (Primary and Secondary): Use manufacturer testing guidelines in documents such as OPW FlexWorks Flexible Piping Installation Instructions (attached)
        ii. Alternatively, if allowed by manufacturer, use PEI C-2: Piping Secondary Containment Integrity Testing form (attached)
        iii. Spill Bucket Integrity Testing: Use PEI RP1200 C-3 Spill Bucket Integrity Testing Hydrostatic Test Method Single- and Double-Walled Vacuum Test Method form (attached)
        iv. Containment Sump (STP and UDC) Testing: Use PEI RP1200 C-4 Containment Sump Integrity Testing Hydrostatic Method form (attached)
    c. POST-INSTALLATION:
        i. Third-Party Testing Vendor
            1. Spill Bucket Integrity Testing: Use PEI RP1200 C-3 Spill Bucket Integrity Testing Hydrostatic Test Method Single- and Double-Walled Vacuum Test Method form (attached)
            2. Precision (0.1 gph) Tank Tightness Testing: Forms are created by the testing equipment manufacturer and vary according to the specific tank test method. For example: Volumetric/Non-Volumetric, Pressure/Vacuum, Ultrasonic, Mass-Based, etc.
            3. Precision (0.1 gph) Line Tightness Testing: Forms are created by the testing equipment manufacturer and vary according to the specific tank test method
            4. Line Leak Detector Testing: Use PEI RP1200 C-9 Mechanical and Electronic Line Leak Detectors Performance Tests form (attached)
            5. Stage I Air Quality Testing: Required only in certain jurisdictions (depending on throughput, distance to residential areas, etc.). Check with the appropriate jurisdiction for a complete list of required tests. Follow applicable CARB standards, forms, and processes. May include among other tests:

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a. Static Torque of Rotatable Phase I Adaptors (CARB Test method TP 201.1B)
b. 2-Inch WC Pressure-Decay Test of Tanks (TP-201.3)
c. Pressure/Vacuum Vent Valves (TP-201.1E)

ii. Third-Party Testing Vendor or Installation Vendor
    1. Overfill Alarm Operation Inspection Testing: Use PEI RP1200 C-6 Overfill Alarm Operation Inspection form (attached)
    2. Automatic Tank Gauge Operation Inspection Testing: Use PEI RP1200 C-7 Automatic Tank Gauge Operation Inspection form (attached)
    3. Liquid Sensor Functionality Testing: Use PEI RP1200 C-8 Liquid Sensor Functionality Testing form (attached)

iii. General Note: Please note that certain jurisdictions (for example, NM and CA) may require submission of separate and additional testing and forms. The latest version of any test form and procedure should always be used. Installation vendors are expected to stay abreast of the specific requirements in their service areas and follow them accordingly.

FIBERGLASS STORAGE TANK

INSTALLATION INSTRUCTIONS & OPERATING GUIDELINES



PETROLEUM TANKS
FLOWTITE® WATER TANKS
OIL / WATER SEPARATORS
CHEMICAL TANKS

CONTAINMENT SOLUTIONS®

VERSION J 05/15

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Field Service Department
Mt. Union, Pennsylvania
(800) 822-1997 • (814) 542-8520

Tank Technical Support
Conroe, Texas
(800) 537-4730 • (936) 756-7731

1. INTRODUCTION

1.1. The purpose of this manual is to provide specifiers, owners and contractors with detailed instructions for installing and operating Containment Solutions, Inc. (CSI) single and double-wall fiberglass underground storage tanks and oil/water separators.

1.2. CSI Tank installation is a specialized business. If you do not have the proper experience and have not completed CSI training for tank installation in the last 24 months, please contact a trained contractor or call CSI for a list of trained contractors.

1.3. These instructions have been developed and refined from the experience of over 300,000 tank installations.

1.4. Proper installation is required to assure the long-term performance of CSI Storage Tanks. These instructions must be followed. Failure to comply will void the limited warranty and may cause tank failure.

1.5. It is the responsibility of the owner, installer and operator to understand and follow all installation requirements.

1.6. Safety

1.6.1. These instructions should not be interpreted in any way to put one's health at risk, or to harm property and/or the environment.

1.6.2. Keep this manual available at the installation site and refer to safety procedures as needed.

1.6.3. The following definitions will serve as a guide when reading this manual:

⚠WARNING

Indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation, which if not avoided may result in minor or moderate injury.

NOTICE

Indicates a potentially hazardous situation, which if not avoided may result in property damage.

1.7. Important Information

1.7.1. Proper installation of each tank is essential:

1.7.1.1. To ensure the safety of all the individuals involved in the tank installation.

1.7.1.2. To prevent tank damage and/or failure, which could lead to product loss and environmental contamination.

1.7.1.3. To validate the tank limited warranty.

1.8. Important Reminders

1.8.1. In addition to these instructions, the installation must comply with NFPA (30, 30A, and 31), OSHA and all applicable Federal, State, Local, or Provincial, construction, safety and environmental codes and regulations.

1.8.2. Any variances or deviations which are in direct conflict with these published installation instructions must be approved in writing prior to the installation by Containment Solutions Tank Technical Support.

1.8.3. U.S. federal law (the Resource Conservation and Recovery Act (RCRA), as amended (Pub. L. 98-616)) requires owners of certain underground storage tanks to notify designated state or local agencies by May 8,1986, of the existence of their tanks. Notifications for tanks brought into use after May 8, 1986, must be made within 30 days. Consult EPA's latest regulations to determine if you are affected by this law.

1.8.4. These instructions provide the minimum requirements for the successful installation of a fiberglass underground storage tank. CSI does not design or engineer the actual installation. The owner's Engineer of Record for the installation can exceed these minimum requirements and is responsible for the final design.

1.8.5. The presence of any CSI representative at the job site does not relieve the contractor of responsibility to follow these installation instructions.

1.9. Tank Limited Warranty Activation

1.9.1. These instructions must be followed.

1.9.2. Installing contractor must be trained in accordance with the CSI contractor training course in effect at the time of the installation.

1.9.3. The Tank Installation Checklist must be properly completed and signed by the tank owner's representative and the installing contractor at the time of installation.

1.9.4. The tank installation checklist, these instructions, and any correspondence related to the tank installation must be retained by the tank owner. The checklist will be required and must be provided to CSI when making a warranty claim.

1.9.5. The limited warranty in effect at the time of tank delivery will apply and is available online at www.containmentsolutions.com.

1.9.6. The CSI limited warranty applies only to a tank installed according to these instructions.

1.9.7. It is the responsibility of the owner and operator to follow all CSI operating guidelines and all limitations in the tank warranty.

1.10. Before You Begin

1.10.1. Read, understand and follow these instructions.

1.10.2. Barricade the tank area until the job is completed.

1.10.3. Review and prepare to complete the installation checklist.

1.10.4. Check with local authorities for building codes, underground utilities and testing requirements.

1.10.5. If you have installation questions or need alternate installation methods, contact CSI Tank Technical Support.

1.10.6. If you have other questions regarding tank modifications, such as adding fittings or manways or tank repair, contact Containment Solutions Field Services.

1.10.7. A list of supplemental documents is found in Section 21.

⚠WARNING

Do not enter tank or sumps unless following OSHA guidelines for confined space entry. Failure to follow OSHA guidelines could result in death or serious injury.



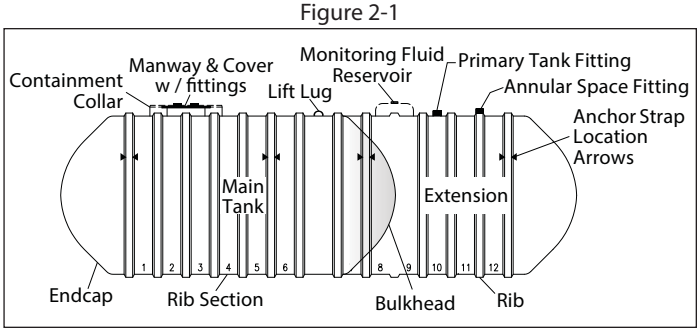
ASPHYXIATION FIRE EXPLOSION

2. HANDLING & STORAGE

2.1. Common Terms for:

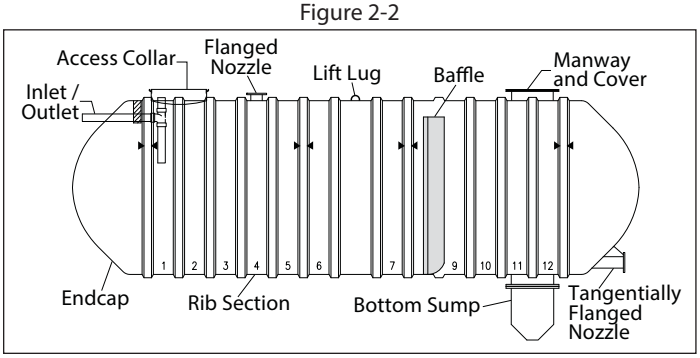
2.1.1. Petroleum Tanks (see Figure 2-1).

Figure 2-1



2.1.2. Non Petroleum Tanks (see Figure 2-2)

Figure 2-2



⚠WARNING

Straps securing the tank to the truck should never be released before the appropriate lifting equipment is properly secured to the tank's lift lugs, and until everyone is positioned in a safe location to avoid injuries. Failure to do so could result in personal injury or death.

2.1.3. The contractor is responsible for rigging, unloading and securing the tank.

2.1.4. Tanks must be mechanically unloaded under the direction of a qualified rigger. Insure lifting equipment is rated to handle the load before lifting.

2.1.5. Upon tank delivery and when lifting tank, visually inspect entire exterior surface of the tank for shipping or handling damage. If the tank has a wet annular space, inspect for monitoring fluid on the exterior surface.

2.1.6. Sign all shipping papers accepting the tank as delivered. Any damage observed must be noted in these papers.

2.1.7. Before unloading a tank from the truck, the contractor must make sure all deadmen, tools, hardware, supplies and anything else capable of damaging the tank are removed from the trailer bed.

2.1.8. The contractor is responsible for making sure the tank is secure before removing shipping straps so the tank does not roll off the truck or trailer.

2.1.9. For tanks with a bottom sump or bottom fittings, be sure the bottom sump or fittings are not damaged by contact with any object. Refer to Supplemental Documents (Section 21) for additional information.

2.1.10. Tank must be properly unloaded prior to air/soap testing.

2.1.11. For temporary storage of tanks at job site:

2.1.11.1. Set on smooth ground (no protruding rocks or hard objects) or on the shipping pads oriented to allow for tank rotation as needed.

2.1.11.2. Chock with sandbags.

2.1.11.3. If high winds are anticipated, tie the tank down to prevent damage. Do not use wire ropes or chains, and do not place straps over collars or reservoirs.

2.1.11.4. When the tank must be rolled for air/soap test, roll only on shipping pads or smooth surface free of protruding rocks or hard objects. Ensure fittings and/or collars do not come in contact with the ground.

2.1.11.5. Protect collars from water accumulation in freezing conditions or tank damage may occur.

2.2. To Avoid Tank Damage

2.2.1. Do not allow tank to rotate or swing during unloading.

2.2.2. Do not use chains or cables around tanks.

2.2.3. Do not allow metal hardware to contact the tank.

2.2.4. Do not allow fittings, collars, manways, reservoirs, or any accessory to contact ground during rotation.

2.2.5. Do not drop tank.

2.3. Lifting Tanks

⚠WARNING

Do not stand on or under tank while tank is being lifted. This could result in personal injury or death.

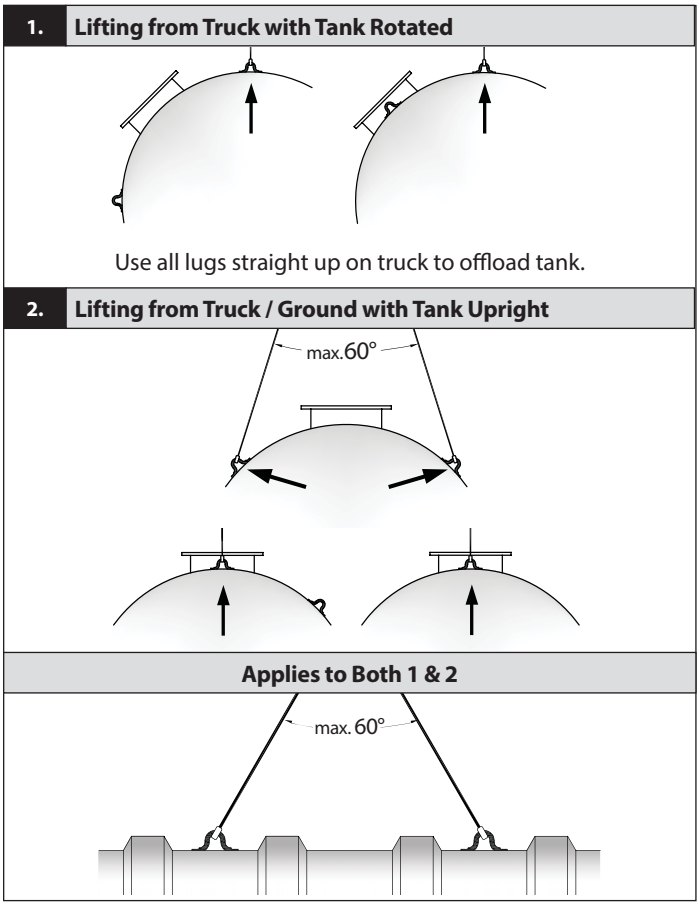
2.3.1. To lift the tank, always use the number of lift lugs indicated on the label adjacent to the lift lugs. Apply equal tension to all lift lugs simultaneously. Slings may also be used to lift the tank. Refer to Supplemental Documents (Section 21) for additional information.

Slings around the tank must be used if the tank is to be handled in a non-level or angled position.

2.3.2. Tanks may be provided with guide lugs for attachment of guide ropes during lifting and positioning operations. Do not use guide lugs for lifting.

2.3.3. Identify the tank lift lug orientation and use the appropriate method to lift the tank. Lift tank as shown in Figure 2-3.

Figure 2-3



2.3.4. Rotate tank after unloading to upright position for lifting into excavation.

2.4. Lifting CSI Deadmen

⚠WARNING

Use only the anchor points when lifting and positioning CSI deadmen. Failure to do so could result in personal injury or death.

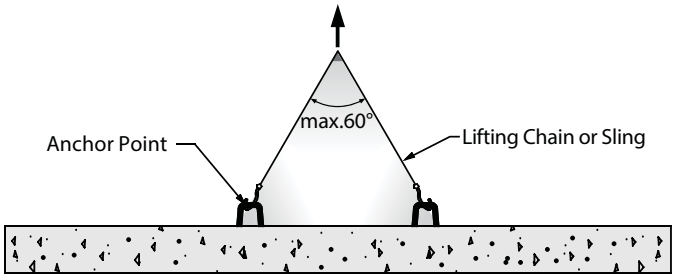
2.4.1. Insure lifting equipment is rated to handle the load before lifting. For deadmen sizes and weights use Table 2-1.

Table 2-1

Deadmen Anchors			
12" x 12"	18" x 8"	Pounds	Kilograms
Length (ft)		Weight	
12		1,655	750
16		2,250	1,020
18		2,550	1,156
20		2,850	1,293
	14	1,686	765
	18	2,100	952
	22	2,500	1,134

2.4.2. Lift deadman using a minimum of two equally spaced anchor points (see Figure 2-4).

Figure 2-4



2.4.3. The deadmen type, lengths, and the number of anchor points are dependent upon the tank diameter, model and capacity. See customer specific drawing for deadman placement and anchoring location details.

2.5. Lifting Tank Sumps or Risers

2.5.1. Visually inspect the sump components for shipping damage. If damage is found, contact CSI Field Services.

2.5.2. Wear gloves.

2.5.3. Do not roll, drop or bounce.

2.5.4. Set on smooth surface.

2.5.5. The sump must be secured to prevent damage from high winds. Proper precautions should be taken to protect adhesive channels.

2.5.6. Refer to Supplemental Documents (Section 21) for additional information on tank sumps.

3. BED & BACKFILL

3.1. The use of approved backfill material is critical to long term tank performance.

3.2. Do not mix approved backfill with sand or native soil.

3.3. Do not backfill tank with sand or native soil.

3.3.1. Replace all excavated native soil with approved backfill of proper size and gradation. Use backfill which meets ASTM C-33 for quality and soundness.

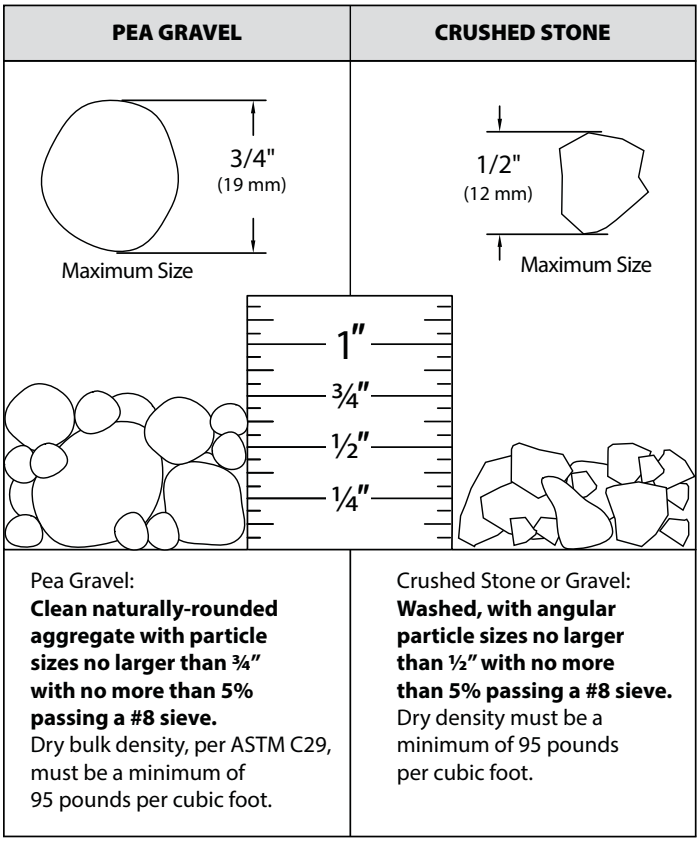
3.3.2. Require your backfill supplier to certify, with a sieve analysis, that the backfill meets this specification.

3.3.3. Sieve analysis must be attached to the Tank Installation Checklist.

3.3.4. Keep backfill dry and free of ice in freezing conditions.

3.3.5. Use only approved pea gravel or crushed stone (see Figure 3-1):

Figure 3-1



3.4. To check your backfill size and receive a job specific email acknowledgment, go to www.containmentsolutions.com, in the search box, use term "backfill".

4. PRE-INSTALLATION TESTING

⚠WARNING

Do not pressurize 4', 6', 8' and 10' diameter tanks over 5 psig (35 kPa). Do not pressurize 12' diameter tanks over 3 psig (21 kPa). Tank damage or physical injury may result.

4.1. The following instructions apply to all air tests described in Section 5 - Testing Tanks.

4.2. Visual Air/Soap Test

4.2.1. To be performed on all tanks after unloading from the truck.

4.2.1.1. Single-Wall and Dry Annular Space Tanks air/soap tests must be performed at the job site prior to installation to verify the absence of damage (Sections 5.1 to 5.6).

4.2.1.2. Liquid Filled Annular Space Tanks - air/soap tests on accessories and fittings can be performed after the tank is in the excavation before or after backfilling (Sections 5.6 to 5.7).

4.2.1.3. Dry annular space tank shipped under vacuum (Section 5.8).

4.2.1.4. Some Non Petroleum tanks are not field air-testable and require a post installation water test (Section 5.9).

4.2.1.5. All tanks must be vented at all times except as defined during testing.

4.3. Prepare for testing.

NOTICE

Do not connect air supply directly to the bulkhead monitor fitting or tank damage will result.

4.3.1. Replace all fitting plugs with plugs suitable for the product to be stored in the tank.

4.3.2. Clean factory pipe dope from plugs and fittings.

4.3.3. Apply pipe dope suitable for the material being stored in the tank.

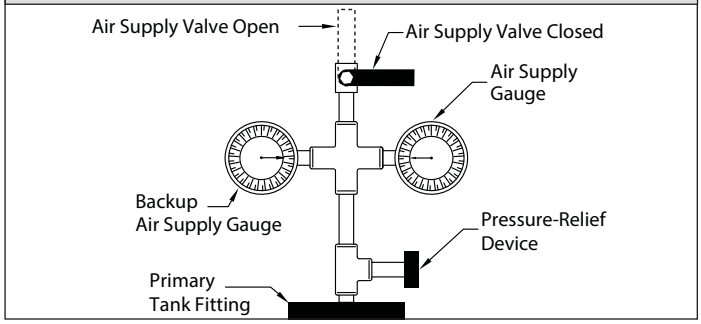
4.3.4. Reinstall and tighten fitting plugs.

4.3.5. Assemble the required number of "Tank Test Manifolds" (Figure 4-1) and "Annular Space Gauge and Valves" (Figure 4-2).

4.3.5.1. Use a contractor supplied "Tank Test Manifold" connected to a tank primary fitting (see Figure 4-1).

Figure 4-1

Tank Test Manifold



4.3.6. Gauges must have a maximum full-scale reading of 15 psig (40 kPa) with ½ psig (3 kPa) or smaller increments.

4.3.7. Pressure-relief device must be sized and set to prevent the tank from being pressurized in excess of the maximum allowed test pressure (6 psig / 41 kPa maximum or 4 psig / 28 kPa for 12' tanks).

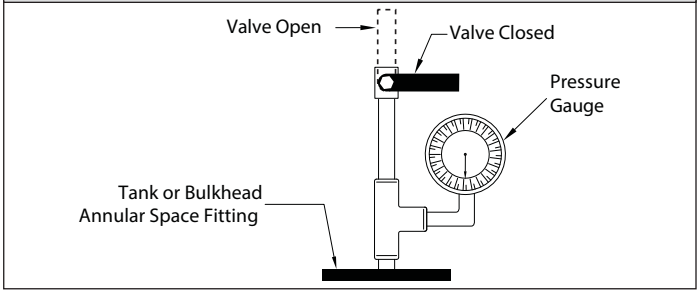
⚠WARNING

Do not stand on or approach endcaps, manways, or fittings while pressurizing tanks. Do not lift or hoist tank under pressure. These actions could result in death or serious injury.

4.3.8. For tanks with any dry annular space configurations, use a contractor supplied "Annular Space Gauge and Valve" connected to the annular space fitting (see Figure 4-2).

Figure 4-2

Annular Space Gauge and Valve



4.4. Do not pressurize 4', 6', 8' and 10' diameter tanks over 5 psig (35 kPa). Do not pressurize 12' diameter tanks over 3 psig (21 kPa).

4.5. Pressure gauge readings can be affected by changes in ambient air temperature. Allow for pressure fluctuations when tanks are subject to temperature changes.

4.6. Prepare Soap Solution.

4.6.1. Warm weather soap solution

- 5 gallons of water
- 8 ounces of household dish washing detergent

4.6.2. Freezing conditions soap solution

- 4 gallons of water
- 8 ounces of household dish washing detergent
- 1 gallon of windshield washer solution

4.7. The entire tank surface must be covered with the soap solution and visually inspected for leaks, as indicated by the presence of active air bubbles.

4.8. Anytime bubbles are observed around fittings, plugs, and gaskets; tighten and retest.

4.9. In the unlikely event a tank leak is discovered, discontinue the installation and immediately call CSI Field Services to schedule a repair.

5. TESTING TANKS

5.1. Testing Single-Wall Tank(s)

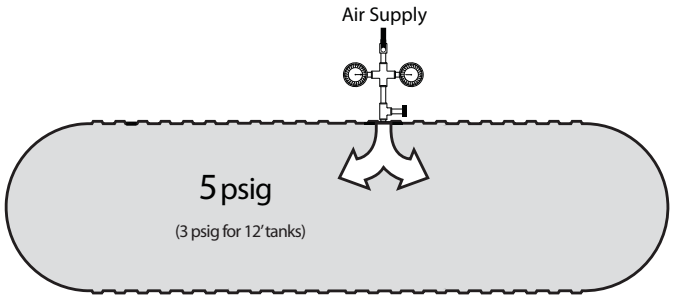
5.1.1. Comply with the requirements of Section 4.

5.1.2. Connect "Tank Test Manifold" to a tank fitting.

5.1.3. Connect the pressure source to the "Tank Test Manifold."

5.1.4. Pressurize tank to 5 psig maximum (3 psig for 12' tanks)(see Figure 5-1).

Figure 5-1



5.1.5. Close the air supply valve to the primary tank.

5.1.6. Disconnect the air supply.

5.1.7. Monitor the pressure readings for 30 minutes for any loss in pressure from the initial reading which may indicate a leak.

5.1.8. While under pressure, cover tank outer surface, including fittings and manway(s), with soap solution and inspect.

5.1.9. After completing air test, release pressure.

5.1.10. Remove all gauges, valves, and hose assemblies.

5.1.11. Replace and tighten fitting plug(s).

5.1.12. Replace the plastic vent plugs in the open fittings.

5.1.13. Refer to INST 6038 for procedure to remove factory equipped on-site pressure test components.

5.2. Double-Wall Tanks Shipped Under Vacuum

NOTICE

Vacuum monitoring is less sensitive and less reliable than the air/soap test. Several variables can affect the accuracy of vacuum monitoring including environmental conditions (e.g. temperature, pressure, altitude) and/or equipment failure.

5.2.1. Pre Installation

5.2.1.1. CSI double-wall tanks may be shipped from the factory with the annular space under vacuum. The vacuum serves to confirm the integrity of the primary and secondary (outer) walls prior to shipment, during shipment, handling, and off loading. This option may expedite tank installation by minimizing testing procedures.

5.2.1.2. Vacuum monitored tanks must be under minimum vacuum for at least 7 days. If this requirement is not met, and air/soap test is required (see Section 4). The date the vacuum was applied to the tank is located on or near the vacuum gauge.

5.2.1.3. Upon arrival of the tank at the job-site, the contractor must record the vacuum date, the arrival date, and the vacuum level from the gauge. This should be done while the tank is on the truck or immediately after off loading.

5.2.1.4. A tank shipped under vacuum can be installed and backfilled with the vacuum intact if both of the following conditions are met:

- The vacuum date precedes the tank installation by at least 7 days.
- The vacuum gauge reads at least 10"Hg (34kPa).

5.2.1.5. If the tank installation date is 7 days or less from the vacuum date OR if the vacuum level is less than 10"Hg, the vacuum on the annular space must be released and both the primary tank and the secondary tank must be tested for tightness before installation and backfilling.

5.2.1.6. If the tank installation date is more than 7 days from the vacuum date and the vacuum level is at least 10" HG, the tank may be backfilled to the tank top while holding vacuum on the annular space.

5.2.2. After backfilling to tank top

5.2.2.1. Pressurize only the primary tank and all compartments while maintaining vacuum on the annular space. Cover fittings and manway(s) with soap solution and inspect.

5.2.2.2. In the unlikely event a tank leak is discovered, discontinue the installation and immediately call CSI Field Services to schedule a repair.

5.2.2.3. After the soap test is complete, release the pressure on the primary tank, release the vacuum on the annular space and remove the gauge, and the gauge piping and seal the annular space fitting.

5.2.2.4. If the vacuum level is ever less than 10"Hg, immediately call CSI Field Services.

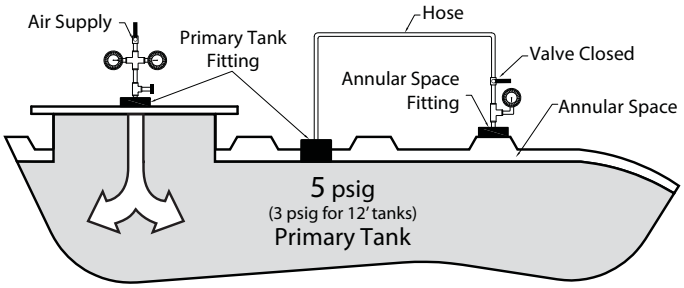
5.3. Testing Double-Wall Tank(s) With Dry Annular Space

NOTICE

Do not connect the air supply directly to the annular space monitoring fitting or tank damage will result.

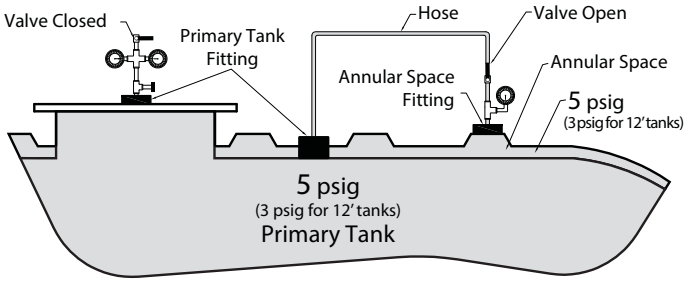
5.3.1. Comply with the requirements of Section 4.
5.3.2. Connect "Tank Test Manifold" to a primary tank fitting.
5.3.3. Connect hose between a primary tank fitting and "Annular Space Gauge and Valve."
5.3.4. Close valve between primary tank and annular space.
5.3.5. Connect the pressure source to the "Tank Test Manifold" on the main tank.
5.3.6. Pressurize primary tank to 5 psig maximum (3 psig for 12' tanks) (see Figure 5-2).

Figure 5-2



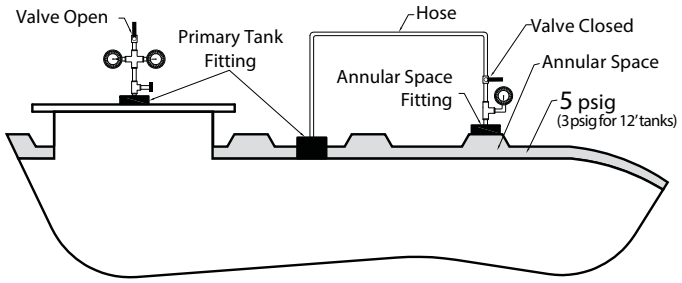
5.3.7. Close the air supply valve to the primary tank.
5.3.8. Disconnect the air supply.
5.3.9. Open valve between primary tank and annular space in order to pressurize the annular space using the existing pressure in the primary tank (pressure in the primary tank may drop slightly) (see Figure 5-3).

Figure 5-3



5.3.10. While under pressure, cover fittings and manway(s), with soap solution and inspect.
5.3.11. Close valve to annular space.
5.3.12. Open valve to vent primary tank.
5.3.13. Maintain pressure on the annular space (see Figure 5-4).

Figure 5-4



5.3.14. Observe and monitor the gauge on the annular space for 30 minutes for any loss of pressure which may indicate a leak.
5.3.15. While under pressure, cover tank outer surface, including fittings and manway(s) with soap solution and inspect.
5.3.16. After completing air test, release pressure.
5.3.17. Remove all gauges, valves, and hose assemblies.
5.3.18. Replace and tighten fitting plug(s).
5.3.19. Replace the plastic vent plugs in the open fittings.

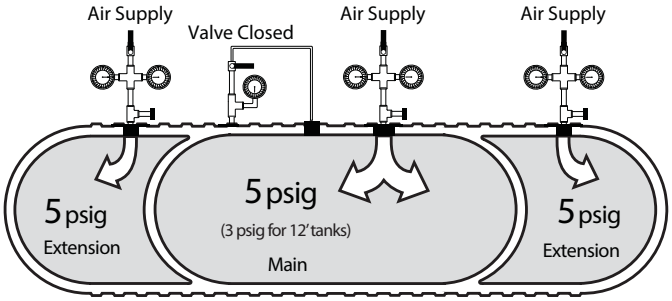
5.4. Testing Double-Wall Compartment Tank(s) With A Dry Annular Space And Double-Wall Bulkhead(s)

NOTICE

Do not connect the air supply directly to the annular space monitoring fitting or tank damage will result.

5.4.1. Comply with the requirements of Section 4.
5.4.2. Connect "Tank Test Manifolds" to each compartment.
5.4.3. Connect hose between a primary tank fitting and "Annular Space Gauge and Valve" (refer to Figure 5-2).
5.4.4. Close valve between primary tank and annular space.
5.4.5. Connect the pressure source to the "Tank Test Manifold" on each compartment.
5.4.6. Pressurize all compartments to 5 psig (3 psig for 12' tanks) (see Figure 5-5).

Figure 5-5

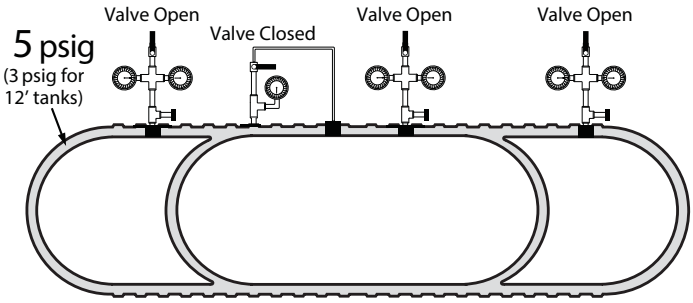


5.4.7. Close valve on each compartment "Tank Test Manifold." Disconnect the air supply line.
5.4.8. Monitor the pressure for 30 minutes for any loss in pressure from the initial reading which may indicate a leak.
5.4.9. With all compartments under pressure, cover fittings and manway(s) with soap solution and inspect.
5.4.10. Open valve between primary tank and annular space in order to pressurize the annular space using the existing pressure in the primary tank (pressure in the primary tank may drop slightly).

5.4.11. Close valve to annular space.

5.4.12. Open valves to vent all compartments (maintain 5 psig on annular space) (see Figure 5-6).

Figure 5-6



5.4.13. Monitor the pressure for 30 minutes for any loss in pressure from the initial reading which may indicate a leak.

5.4.14. While under pressure, cover tank outer surface, including fittings and manway(s), with soap solution and inspect.

5.4.15. After completing air test, release pressure.

5.4.16. Remove all gauges, valves, and hose assemblies.

5.4.17. Replace and tighten fitting plug(s).

5.4.18. Replace the plastic vent plug in the open fittings.

5.5. Testing Double-Wall Tank(s) With Liquid Filled Annular Space (Hydrostatically Monitored)

NOTICE

Never pressurize a wet annular space. Doing so may damage the tank or cause tank failure.

5.5.1. This tank has a hydrostatic monitoring system that includes a green monitoring fluid pre-installed between the tank walls.

5.5.2. In the unlikely event of a tank leak, this monitoring fluid will leave a green trace on the tank.

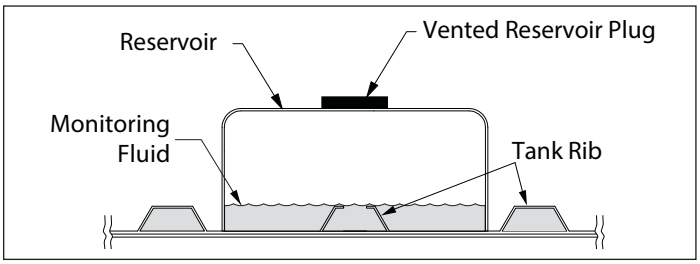
5.5.3. If monitoring fluid is found on the tank inner or outer surface during any test, discontinue the installation and immediately contact Containment Solutions Field Services.

5.5.4. Comply with the requirements of Section 4.

5.5.5. With tank in upright position, remove the 4" vented plug from the reservoir fitting.

5.5.6. Add only enough monitoring fluid to cover the rib inside the reservoir. Do not overfill past the rib at this time (see Figure 5-7). Final monitoring fluid levels will be set later in the installation process.

Figure 5-7



5.5.7. Reinstall vented reservoir plug to ensure annular space is vented at all times.

5.5.8. Remove enough tank fitting plugs to see inside the primary tank.

5.5.9. With a light, look inside for any monitoring fluid.

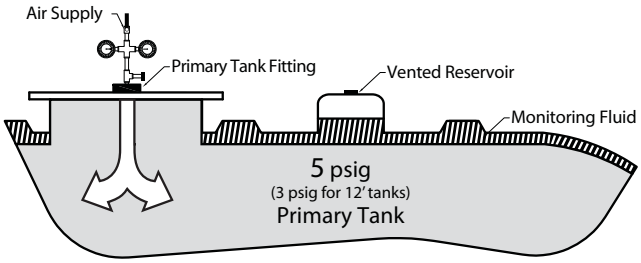
5.5.10. Replace and tighten fitting plug(s).

5.5.11. Connect "Tank Test Manifold" to a primary tank fitting.

5.5.12. Connect the pressure source to the "Tank Test Manifold."

5.5.13. Pressurize primary tank to 5 psig maximum (3 psig for 12' tanks) (see Figure 5-8).

Figure 5-8



5.5.14. Close valve on "Tank Test Manifold." Disconnect the air supply line.

5.5.15. Monitor the pressure for 30 minutes for any loss in pressure from the initial reading which may indicate a leak.

5.5.16. While under pressure, cover fittings and manway(s) with soap solution and inspect.

5.5.17. After completing air test, release pressure.

5.5.18. Remove all gauges, valves, and hose assemblies.

5.5.19. Replace and tighten fitting plug(s).

5.5.20. Replace the plastic vent plugs in the open fittings.

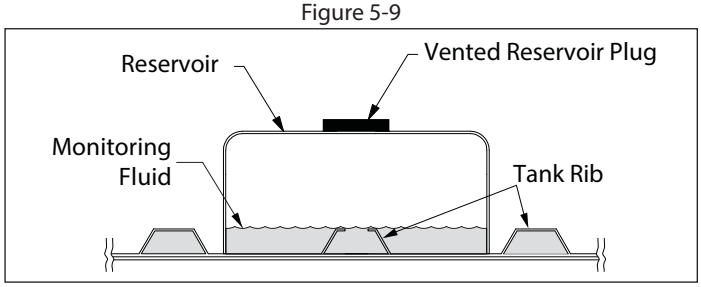
5.6. Testing Double-Wall Compartment Tank(s) With Double-Wall Bulkheads (Hydrostatically Monitored)

NOTICE

Never pressurize a wet annular space. Doing so may damage the primary tank or cause tank failure.

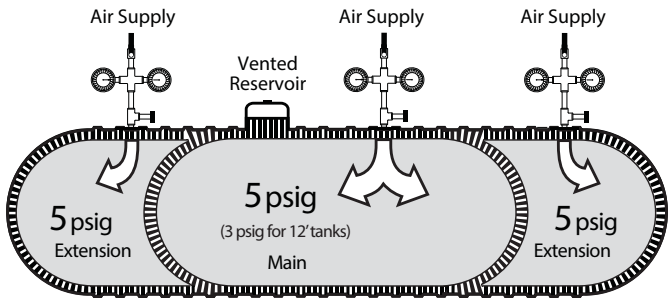
5.6.1. This tank has a hydrostatic monitoring system that includes a green monitoring fluid pre-installed between the tank walls.
5.6.2. In the unlikely event of a tank leak, this monitoring fluid will leave a green trace on the tank.
5.6.3. If monitoring fluid is found on the tank inner or outer surface during any test, discontinue the installation and immediately contact Containment Solutions Field Services.
5.6.4. Comply with the requirements of Section 4.
5.6.5. With tank in upright position, remove the 4" vented plug from the reservoir fitting.
5.6.6. Add only enough monitoring fluid to cover the rib inside the reservoir. Do not overfill past the rib at this time (see Figure 5-9). Final monitoring fluid levels will be set later in the installation process.

Figure 5-9



5.6.7. Reinstall vented reservoir plug to ensure annular space is vented at all times.
5.6.8. Remove enough tank fitting plugs to see inside each compartment.
5.6.9. With a light, look inside for monitoring fluid.
5.6.10. Replace and tighten fitting plug(s).
5.6.11. Connect "Tank Test Manifold(s)" to each compartment.
5.6.12. Connect the pressure source to the "Tank Test Manifold" on each compartment.
5.6.13. Pressurize all compartments to 5 psig (3 psig for 12' tanks) (see Figure 5-10).

Figure 5-10



5.6.14. Close valve on each "Tank Test Manifold." Disconnect the air supply line.
5.6.15. Monitor the pressure for 30 minutes for any loss in pressure from the initial reading which may indicate a leak.
5.6.16. With all compartments under pressure, cover fittings and manway(s) with soap solution and inspect.
5.6.17. After completing air test, release pressure.
5.6.18. Remove all gauges, valves, and hose assemblies.
5.6.19. Replace and tighten fitting plug(s).
5.6.20. Replace the plastic vent plug in the open fittings.

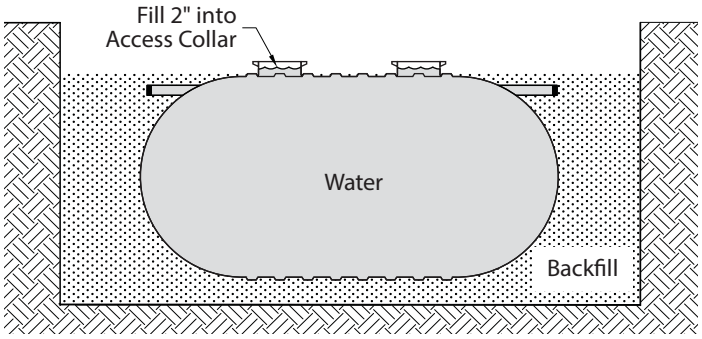
5.7. For Tanks That Cannot Be Air Tested (May Apply For Certain Non-UL Tanks)

NOTICE

If the tank is to be water tested, it must be supported by backfill on all sides to the top of the tank. Failure to do so may result in tank damage.

5.7.1. These instructions are for tanks that require a post installation water test.
5.7.2. Comply with the requirements of Section 4.
5.7.3. Tanks may only be water tested if the backfill is at tank top (see Figure 5-11).

Figure 5-11



5.7.4. Expose tank penetrations on tank top by temporarily removing backfill.
5.7.5. So water does not exit the inlet/outlet pipe, install a turned up elbow or plug.
5.7.6. Completely fill the tank with water to a level 2" into the access collar(s).
5.7.7. Wait at least 30 minutes, if the water level in the collar does not drop more than ¼", the tank is considered acceptable and leak free.
5.7.8. If the level drops more than the ¼", ensure that inlet and outlet pipe caps or plugs and collars are not leaking, then refill the tank and retest.
5.7.9. After the tank is proven to be watertight, remove the water in the tank to below the pipe invert.

6. EXCAVATION & TANK CLEARANCE

⚠WARNING

Do not enter the tank excavation unless in compliance with OSHA regulations. Follow OSHA guidelines for tank excavation. Collapsing excavation walls can cause injury or death.

6.1. Stable Excavations

6.1.1. For different diameter tanks that are adjacent to each other, refer to Supplemental Documents (Section 21).

6.1.2. When your excavation is in stable, undisturbed soil; use the minimum spacings (per Figure 6-1 and Table 6-1).

Figure 6-1

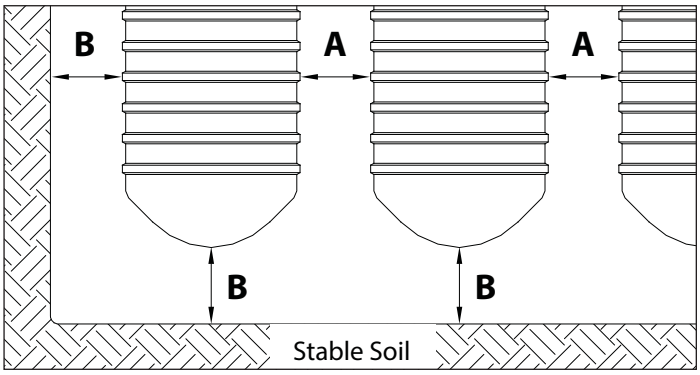


Table 6-1

8' Diameter Tanks		
	Minimum	w/ 12" x12" CSI Deadmen
A	18" (457mm)	24" (610mm)
B	18" (457mm)	24" (610mm)
4', 6', 10' Diameter Tanks		
	Minimum	w/ 18" x8" CSI Deadmen
A	18" (457mm)	36" (914mm)
B	24" (610mm)	24" (610mm)
12' Diameter Tanks		
	Minimum	w/ 18" x8" CSI Deadmen
A	24" (610mm)	36" (914mm)
B	24" (610mm)	24" (610mm)
Spacing between tanks placed end to end will follow the "B" spacing minimum value.		

6.2. Unstable Excavations

6.2.1. An unstable excavation is any of the following:

6.2.1.1. Muck, bog, peat, swamp, quick sand, flowing water, landfill type areas or any other situations where the soil is inherently unstable.

6.2.1.2. Soil less than 750 lbs./sq. ft. cohesion per ASTM D2166 (Test Method for Unconfined Compressive Strength of Cohesive Soil), or have an ultimate bearing capacity less than 3,500 lbs./sq. ft.

NOTICE

If the soil is unstable, the tank owner should consult a professional engineer to ensure a proper installation and avoid the potential for tank or property damage.

6.2.2. A soils consultant can provide additional recommendations, including when a reinforced pad is needed under the tank.

6.2.3. When a bottom pad is used, it should extend to the excavation walls.

6.2.4. Unstable excavations may also require geotextile fabric (see Section 7).

6.2.5. When the soil is unstable, with or without shoring, use the minimum spacings (per Figure 6-2 and Table 6-2).

Figure 6-2

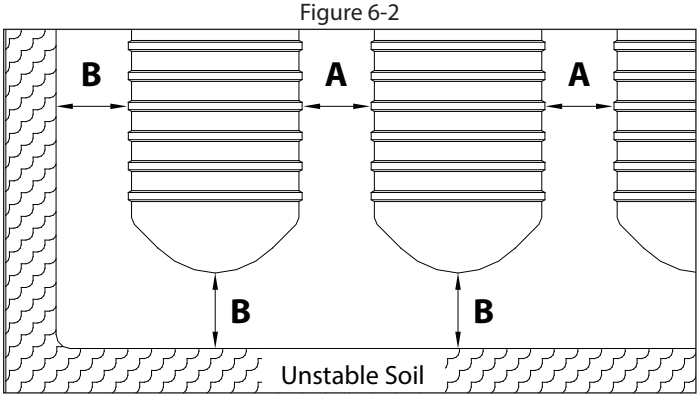


Table 6-2

8' Diameter Tanks		
	Minimum	w/ 12" x12" CSI Deadmen
A	18" (457mm)	24" (610mm)
B	½ Tank Dia.	½ Tank Dia.
4', 6', 10' Diameter Tanks		
	Minimum	w/ 18" x8" CSI Deadmen
A	18" (457mm)	36" (914mm)
B	½ Tank Dia.	½ Tank Dia.
12' Diameter Tanks		
	Minimum	w/ 18" x8" CSI Deadmen
A	24" (610mm)	36" (914mm)
B	½ Tank Dia.	½ Tank Dia.
Spacing between tanks placed end to end will follow the "B" spacing minimum value.		

6.3. Shoring Removal

NOTICE

Removal of shoring can cause backfill to move and tank to lose support, resulting in an excessive tank deflection. Tank and/or property damage can occur.

6.3.1. After the backfill is properly placed completely around the tank(s):

6.3.1.1. Vibrate shoring and pull slowly to top of backfill.

6.3.1.2. Fill any voids created by the pulled shoring with approved backfill.

6.3.2. All shoring should be removed and all voids must be filled using a long handled probe before continuing installation.

6.3.3. If side shoring is left in place, the shoring must not degrade over the life of the installation.

6.3.4. Shoring system components cannot be placed under the tank.

6.4. Tank Location - Nearby Structures

6.4.1. CSI recommends that the tank owner seek the advice of a local foundation professional engineer to determine the proper placement of a tank excavation near any slabs or foundations.

6.4.2. The location of a tank can be affected by the location of nearby structures. When selecting a tank site, care must be taken to avoid undermining the foundations of new or existing structures.

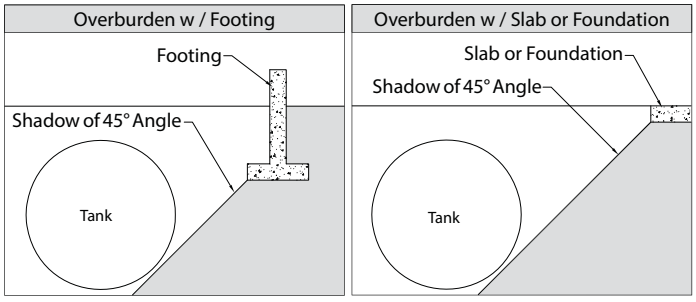
6.4.3. Ensure that downward forces from loads carried by the foundations and supports of nearby structures (constructed before or after tank installation) are not transmitted to the tanks. (Refer to NFPA 30 for additional details).

6.4.4. The placement of the installed underground tank is not designed for any of the following:

6.4.4.1. Additional static loads on the slab that will cause the load at the tank top to exceed 936 lbs/cubic ft.

6.4.4.2. Adjacent slab, footing or foundation that will place loads on the tank top or sides. This is typically accomplished by insuring that the tank is not located within the load distribution of any adjacent slabs or foundations using 45° as the angle of the projected loads (see Figure 6-3).

Figure 6-3



6.4.4.3. Equipment creating vibrations must be placed outside the boundaries of the excavation.

7. GEOTEXTILE FABRIC

7.1. Geotextile fabric (filter fabric) allows the passage of water but prevents the migration of approved backfill into the native soil and native soil into the approved backfill. Migration may compromise the backfill support of the tank.

7.2. Geotextile Fabrics are required for any of the following installations

7.2.1. Areas subject to tidal conditions.

7.2.2. Areas subject to frequently changing ground water levels.

7.2.3. Water conditions with silty soil.

7.2.4. Muck, bog, peat, swamp, landfill type areas or any other situations where the soil is inherently unstable.

7.2.5. Soils with less than 250 lbs./sq. ft cohesion or with ultimate bearing capacity of less than 500 lbs./sq. ft.

7.2.6. Alternate installation methods may also require geotextile fabrics. Refer to Supplemental Documents (Section 21) for additional information.

7.3. The tank owner or tank owner's representative may also specify the use of geotextile fabrics.

7.4. Non-degradable geotextile fabric can be either woven or non-woven and should have the following properties:

- Minimum grab tensile strength of 120 lbs (ASTM D4632).
- Maximum apparent opening size of 0.300 mm #50 US sieve (ASTM D4751).
- Minimum flow rate of 18 gallons/min/ft2 (ASTM D4491).
- Minimum permittivity of 0.28 sec-1 (ASTM D4491).

7.5. Do not use plastic, or any other material that may tear or degrade over time, as a replacement for geotextile fabric.

7.6. Geotextile Fabric Installation

7.6.1. Line the side and bottom of the excavation with geotextile fabric.

7.6.2. Overlap adjoining geotextile panels a minimum 12".

7.6.3. Place backfill on top of the geotextile fabric to hold it in place.

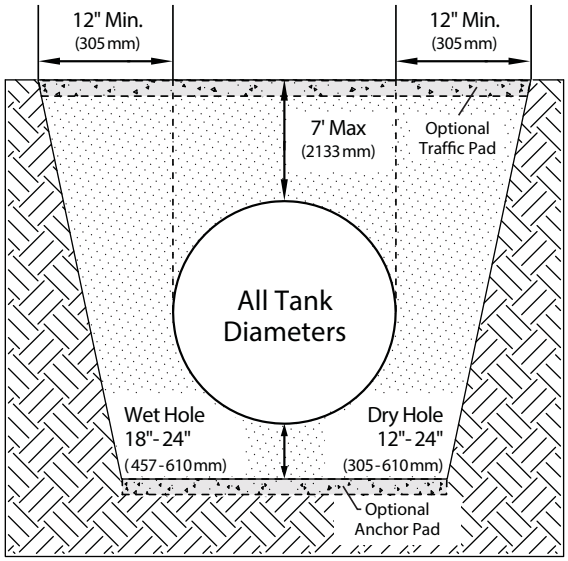
7.6.4. In wet hole conditions, backfill on top of the geotextile fabric is necessary to sink and hold it in place.

8. BURIAL DEPTH & COVER

8.1. Adhere to the minimum and maximum dimensions in this section.

8.2. In wet conditions, sufficient overburden and/or an appropriate anchoring system must be used to offset buoyancy of the tank. Minimum burial depth (section 8) may not be sufficient to anchor the tank in buoyant conditions. Refer to the "Anchor Chart" (Appendix A) for minimum burial depth in buoyant conditions.

Figure 8-1



8.2.1. Traffic pad must extend at least 12" beyond tank perimeter in all directions.

8.2.2. The maximum burial depth is 7' from the tank top to grade elevation. Tanks can be designed for burial depths greater than 7'. Contact your local CSI representative prior to tank purchase.

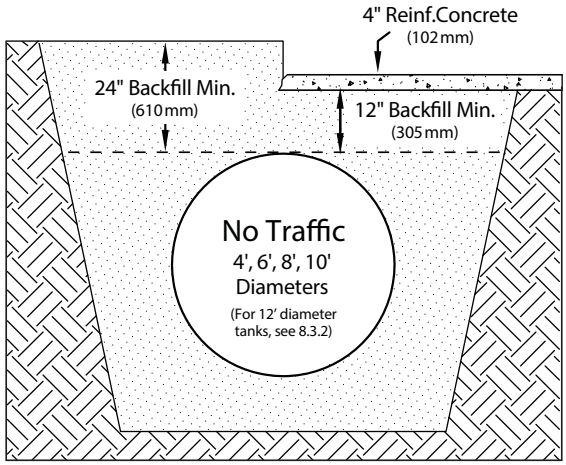
8.2.3. Dry hole excavations must have a minimum of 12" and a maximum of 24" backfill between the bottom of the tank and either the bottom of the excavation or the top of the concrete anchor pad.

8.2.4. Wet hole excavations must have a minimum of 18" and a maximum of 24" backfill between the bottom of the tank and either the bottom of the excavation or the top of the concrete anchor pad.

8.3. Minimum Burial Depth - No Traffic Load

8.3.1. 4' - 10' tanks need a minimum cover of 24" backfill or 12" backfill plus 4" reinforced concrete (see Figure 8-2).

Figure 8-2



8.3.2. 12' tanks need a minimum cover of 42" backfill or 38" backfill plus 4" reinforced concrete.

8.3.3. Local codes may require deeper minimum burial depth.

8.4. Minimum Burial Depth -Traffic Loads

NOTICE

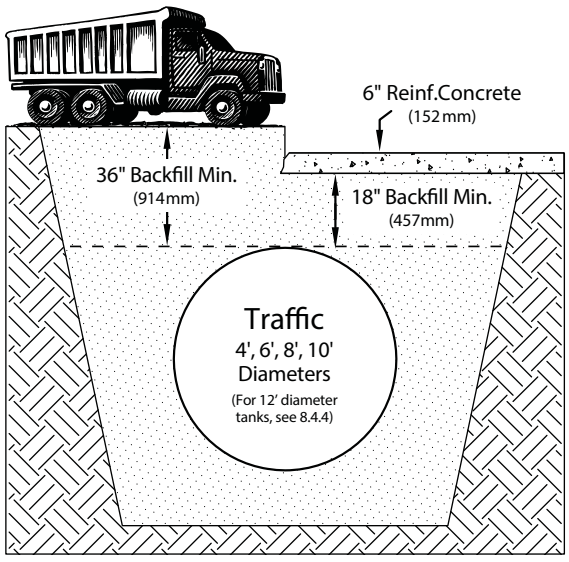
Without a concrete traffic pad, soil must be consolidated such that rutting of the soil will not occur from any equipment or vehicles.

8.4.1. The following burial depths are suitable for HS20 traffic loads (32,000 lbs/axle).

8.4.2. The concrete traffic pad, reinforcement and thickness, must be designed for job conditions and traffic loads to assure concrete traffic pad integrity. It is the responsibility of the tank owner or tank owner's representative to design the traffic pad for all loads.

8.4.3. 4' - 10' tanks need a minimum cover depth of 36" backfill or 18" of backfill plus 6" of reinforced concrete (see Figure 8-3).

Figure 8-3



8.4.4. 12' tanks need a minimum cover of 48" backfill or 36" backfill plus 6" reinforced concrete.

9. ANCHORING

NOTICE

Every site should be evaluated for buoyant conditions including but not limited to local water tables, flooding and trapped water. Failure to provide sufficient overburden and/or appropriate anchoring may result in tank failure and property damage may occur.

9.1. It is the responsibility of the tank owner or tank owner's representative to determine the appropriate anchoring method and to design the anchoring system.

9.2. CSI has provided an "Anchor Chart" at the end of this instruction booklet (Appendix A) that covers the minimum burial depths for the three common methods of anchoring tanks.

9.3. The three common methods are:

- Deadmen Anchors
- Concrete Anchor Pad
- Overburden (no mechanical anchoring)

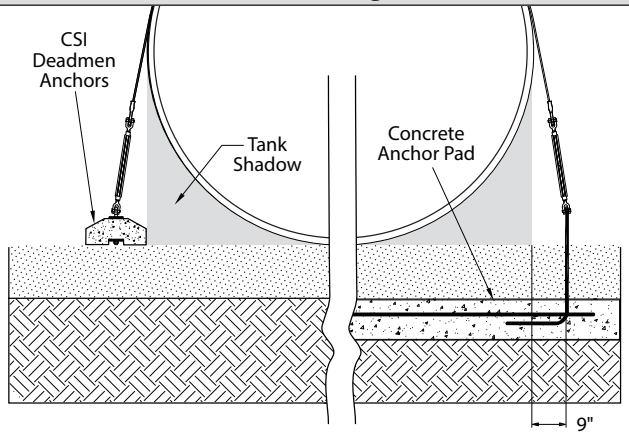
9.4. CSI offers an engineered mechanical anchoring system designed for each size tank consisting of deadman anchors, straps, and hardware.

9.5. Burial depth, straps, turnbuckles, shackles, wire rope, deadmen and anchor pads can be combined to provide anchoring using the information provided in this section.

9.6. The mechanical anchoring methods are shown in Figure 9-1.

Figure 9-1

Mechanical Anchoring Methods



9.7. General Anchoring Requirements

NOTICE

Metal hardware (strap ends, wire rope, and turnbuckles) should never be in direct contact with any portion of the tank or tank damage may occur.

9.7.1. Prior to anchoring, take the first deflection measurement after the tank is lowered into the excavation. If mechanical anchoring is used, take the second deflection measurement of the tank after the anchoring is complete and record the results on the Tank Installation Checklist (Additional information on deflection measurements can be found in Section 11).

9.7.2. Use only CSI anchor straps

9.7.3. Use correct length anchor straps for each diameter tank.

9.7.4. Anchor points must be aligned with designated anchor ribs ►◄ (±1"). Do not use straps between ribs except on 4' tanks.

9.7.5. Maintain proper distance between anchor points across the diameter of the tank:

9.7.5.1. For deadmen, place inside edge of deadman at the tank shadow.

9.7.5.2. For bottom anchor pad, position anchor point 6" from tank shadow for 4', 6', and 8' tanks; 9" for 10' and 12' tanks.

9.7.6. All anchor straps must be uniformly tightened with turnbuckles or come-a-longs. Straps should be snug, but not cause tank deflection.

9.8. Anchor Point Loads

9.8.1. For any anchoring system, the tank strap and all hardware should be designed for the following maximum working loads which will provide a minimum 3:1 factor of safety (see Table 9-1).

Table 9-1

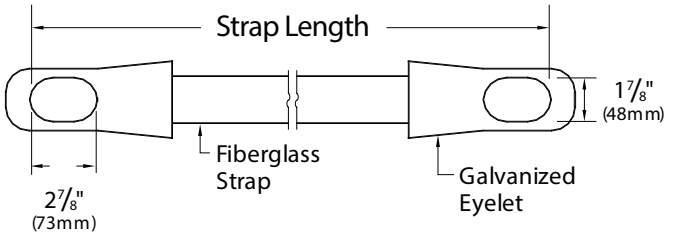
Anchor Point Load Allowed	
Tank Diameter	Maximum Load
4'	1,261 lbs (572 kg)
6'	5,405 lbs (2,452 kg)
8'	7,508 lbs (3,406 kg)
10'	7,508 lbs (3,406 kg)
12'	7,508 lbs (3,406 kg)

9.8.2. The installing contractor is responsible for providing hardware and anchor points of sufficient size and strength.

9.8.3. For specific information on hardware and usage, consult the hardware manufacturer or supplier.

9.9. Standard Eye by Eye Hold Down Strap

Figure 9-2

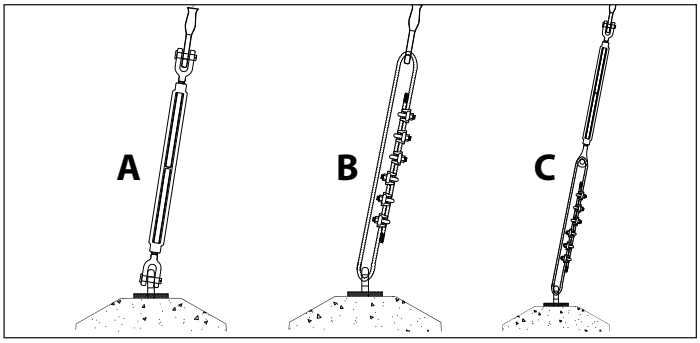


Tank Diameter	Strap Length
4'	100" (2,546mm)
6'	141" (3,185mm)
8'	176" (4,464mm)
10'	238" (6,045mm)
12'	271" (6,877mm)

9.10. When connecting the end of a hold-down strap to the anchor, common methods include: (see Figure 9-3)

- Drop-forged turnbuckle (A)
- Looped wire rope (B)
- Combination of both A and B (C)

Figure 9-3



9.10.1. After hardware is installed, all exposed metal on the anchoring system must be coated or galvanized to protected against corrosion.

9.11. Drop-Forged Turnbuckles

9.11.1. May be used in place of all or a portion of wire rope described in this section.

Table 9-2

Tank	Minimum Turnbuckle Diameter (by type)			
Dia.	Hook	Jaw	Eye	Minimum Working Load Limit*
4'	½"	⅜"	⅜"	1,200 lbs
6'	¾"	½"	½"	2,200 lbs
8'	1¼"	¾"	¾"	5,200 lbs
10'	1¼"	¾"	¾"	5,200 lbs
12'	1¼"	¾"	¾"	5,200 lbs
* ultimate load should be 5 times working load limit.				

9.12. Wire Rope

9.12.1. A method to use wire rope on the ribs over the tank top is available. Refer to Supplemental Documents (Section 21) for additional information.

9.12.2. Use 6 x 19 Improved Plow Steel IWRC, or better, wire rope.

9.12.3. Refer to Table 9-3 for minimum wire rope diameter and strength.

Table 9-3

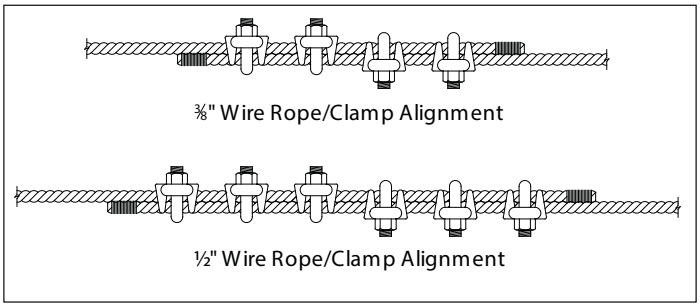
Wire Rope		
Tank Diameter	Minimum Diameter	Minimum Ultimate Strength
4'	⅜" (10mm)	13,120 lbs (5,951 kg)
6', 8', 10', 12'	½" (13mm)	23,000 lbs (10,433 kg)

9.12.4. Follow recommendations of the wire rope manufacturer, as well as all industry standards when selecting, handling, attaching or connecting wire rope.

9.12.5. Tighten all hardware uniformly and follow the manufacturer's torque specifications. Double check the tightness once the anchoring system is complete.

9.12.6. When forming a loop in the wire rope, a splice is required for connecting the two ends together. Use a minimum of four clamps for ⅜" wire rope and a minimum of six clamps for ½" wire rope. Place the rope ends parallel to each other and install the clamps as shown in Figure 9-4.

Figure 9-4



9.13. Deadmen Anchors

9.13.1. Deadmen are made of reinforced concrete, designed according to the American Concrete Institute (ACI) code, placed end to end equal to tank length, and with at least two anchor points per deadman.

9.13.1.1. Refer back to Table 2-1 for CSI deadmen dimensions and weight.

9.13.1.2. Each tank requires its own deadman on both sides, or if one deadman is used between adjacent tanks, it must be doubled in width.

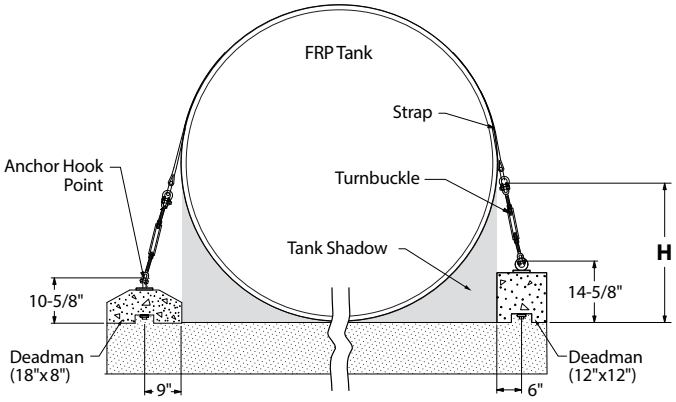
9.13.1.3. A separate anchor point must be provided for each strap.

9.13.1.4. CSI deadmen are engineered and sized to the tank ordered.

9.13.1.5. Placement of CSI deadmen is the same as standard deadmen.

9.13.1.6. Lay the deadmen in the excavation parallel to the tank and at the outside edge of the tank shadow (see Figure 9-5).

Figure 9-5



Tank Diameter	*Dimension H
4'	See supplemental documents in section 21
6'	27"
8'	36"
10'	42"
12'	50"

* This dimension is the distance from the hook point on the anchor strap to the bottom of the deadman.

9.13.1.7. CSI deadmen are supplied with ¾" diameter, galvanized, adjustable anchor points.

9.13.1.8. Move anchor points to match the hold-down strap locations on the tank ►◄ ±1" with CSI split straps. This must be done before placing deadmen in the hole.

9.13.1.9. Place multiple deadmen, in contact, end to end.

9.13.1.10. Use one anchor point per strap end.

9.14. Concrete Anchor Pad

9.14.1. The weight of the overburden acting on the concrete anchor pad and the tank provides the anchoring force (not the weight of the concrete anchor pad).

9.14.1.1. As a minimum, to counteract buoyancy, the anchor pad for stable excavations must be at least 8" thick, with #6 rebar on 12" centers each way, constructed per current ACI code.

9.14.1.2. For stable conditions the pad must extend a minimum of 18" beyond the tank shadow. The pad must also be at least the same length as the tank.

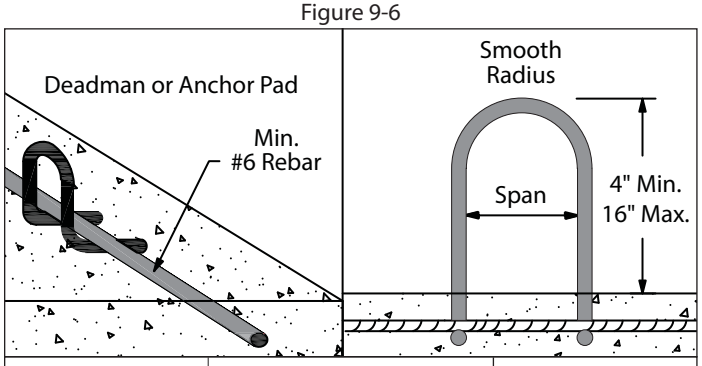
9.14.1.3. For unstable excavations, it is the responsibility of the tank owner or tank owner's representative to design the bottom pad thickness and reinforcement. Regardless of design, the anchor pad should extend to the excavation walls.

9.14.1.4. Poor soil conditions, local codes, seismic activity, etc. may require increased reinforcement and anchor pad thickness. Contact a soils consultant for specifications.

9.14.2. Embedded anchor points should be designed for the working loads in Table 9-1.

9.14.3. When embedding anchor points at the time the pad is fabricated, the following design will meet the minimum required anchor points (see Figure 9-6).

Figure 9-6



Tank Diameter	Minimum Rebar Loop Size (1 strap/anchor point)	Rebar* Span
4'	#6	7½"
6'	#8	10½"
8'	#8	10½"
10'	#10**	13½"
12'	#10**	13½"

* Note: Wider or narrower span will reduce the strength of the anchor points below the required value.

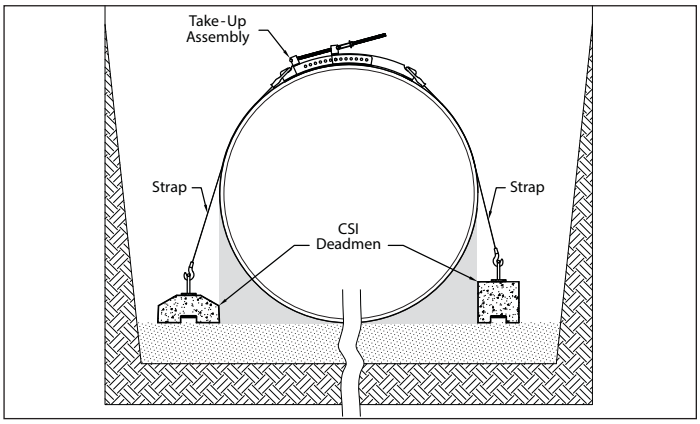
** ¾" turnbuckles require a wire rope loop or shackle between turnbuckle and rebar anchor point because #10 rebar will not fit into ¾" eye turnbuckle.

9.15. Split Strap Anchoring System

9.15.1. The CSI split strap anchor system is designed for use in installations when personnel may not enter the hole. This system includes a two part strap and take-up assembly at the tank top that may be used in conjunction with CSI deadmen.

9.15.2. When using the split strap anchoring system, the placement of components is critical (see Figure 9-7). For detailed instructions on using the split strap anchor system refer to Supplemental Documents (Section 21).

Figure 9-7



10. BALLASTING TANKS (ADDING LIQUID)

10.1. A tank is not adequately protected against flotation until the tank is backfilled to subgrade and the top slab is in place.

10.2. For a tank that is not fully installed, water can enter the hole and the tank will float unless it has been ballasted with fluid to offset buoyancy.

10.3. Use water or fluid heavier than water as ballast. Be sure the ballast will not contaminate the product being stored or clean the tank before product is added. This is especially important for potable water, chemical and diesel exhaust fluid (DEF) tanks.

10.4. Do not make a direct (hard) connection of the ballast fill line to any tank fitting.

10.5. Adding ballast:

NOTICE

Do not have the annular space connected to the primary space during ballasting or tank damage will occur.

NOTICE

When adding ballast, precautions must be taken so that the tank cannot completely fill. Keep tank vented to prevent pressurization of the tank when adding ballast. As the tank nears full, reduce the fill rate to prevent sudden pressurization or tank damage will occur.

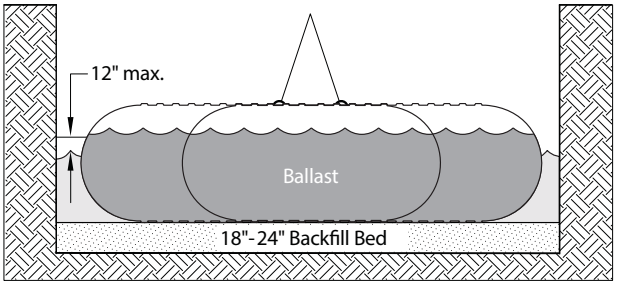
10.5.1. At the moment the tank is full, the pressure in the fill line will result in an instant pressurization of the tank which will damage the tank.

10.5.2. This problem can be avoided by providing adequate tank venting or removing the fill line and manually bringing the tank to full capacity.

10.6. Dry Hole - add ballast only after backfill is placed at least 75% of the tank diameter.

10.7. Wet Hole - Add enough ballast to sink the tank. Ballast level inside the tank and in all compartments should be equal (to keep tank level) and not more than 12" above the ground water level outside the tank (see Figure 10-1).

Figure 10-1



11. TANK INSTALLATION

⚠WARNING

Do not enter the tank excavation unless all OSHA requirements are followed. Collapsing excavation walls may cause death or serious injury.

11.1. Before You Begin

11.1.1. It is important to review all instructions to make sure you are compliant with the proper procedures. This includes:
- Bed and Backfill
- Pre-Installation Testing
- Hole Size/Burial Depth
- Anchoring

11.2. Tank Vertical Diameter Measurements

11.2.1. Each vertical diameter measurement is used to determine the tank's deflection. If at any point the deflection measurements exceed the values in Table 11-1, stop the installation and contact Tank Technical Support.

11.2.2. During installation, vertical diameter measurements must be taken and recorded on the Tank Installation Checklist after each of the following steps:

11.2.2.1. "First Vertical Diameter Measurement"
- Placement of tank on backfill bed

11.2.2.2. "Second Vertical Diameter Measurement"
- Anchoring completed (only applicable if mechanical anchoring is used).

11.2.2.3. "Third Vertical Diameter Measurement"
- Backfill to tank top.

11.2.2.4. "Fourth and Fifth Vertical Diameter Measurements"
- Backfill to subgrade, before the concrete pad.

11.2.3. Separate vertical diameter measurements must be recorded for each tank compartment.

11.2.3.1. All measurements for vertical deflection are made from the bottom of the tank to the bottom of the fitting.

11.2.3.2. All measurements should be made in inches or millimeters using a standard nonmetallic gauge stick.

11.2.3.3. All measurements should be made through the fitting closest to center of tank or each compartment.

11.2.4. Refer to Table 11-1 for maximum deflection values.

11.3. Installation Procedure

Table 11-1

Tank Diameter	Maximum Deflection	
4'	½"	(12mm)
6'	¾"	(19mm)
8'	1¼"	(31mm)
10'	1½"	(38mm)
12'	1¾"	(44mm)

11.3.1. Determine if geotextile fabric is required for your installation (see Section 7 for details).

11.3.2. All tank holes must have a minimum of 12" (18" for wet holes) and a maximum of 24" of approved backfill between the bottom of the tank and the bottom of the excavation or concrete anchor pad.

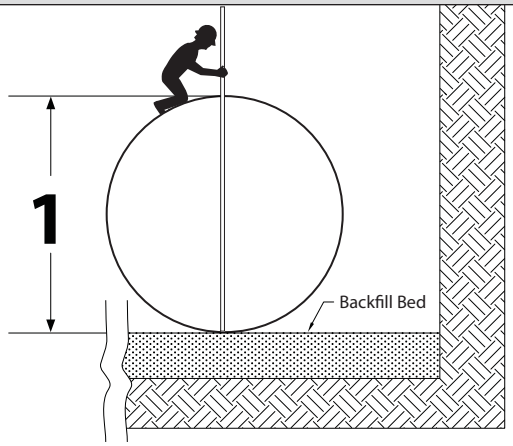
11.3.3. Place tank in excavation with lifting cables attached to lift lugs provided on tank, while maintaining control of tank with guide ropes.

11.3.4. Set tanks directly on backfill bed.

11.3.5. Take the "First Vertical Diameter Measurement" and record the value on the Tank Installation Checklist (see Figure 11-1).

Figure 11-1

First Vertical Diameter Measurement

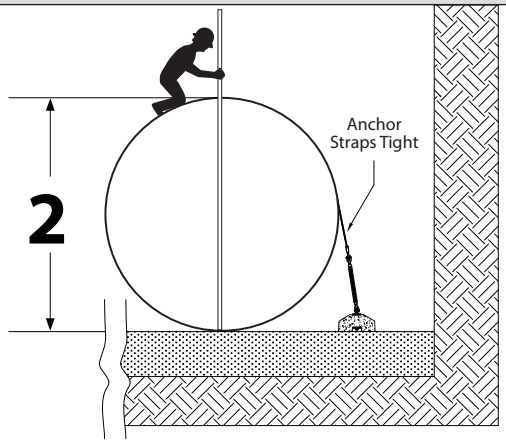


Measure from the bottom of the tank to the bottom of the fitting.

11.3.6. If mechanical anchoring is used, after anchoring is completed, take the "Second Vertical Diameter Measurement" and record the value on the Tank Installation Checklist. If this value does not equal the "First Vertical Diameter Measurement", loosen the anchor straps (see Figure 11-2).

Figure 11-2

Second Vertical Diameter Measurement

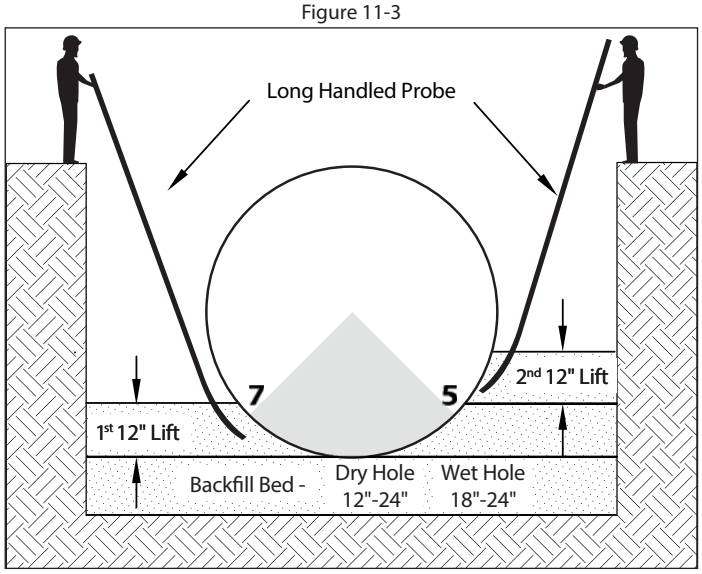


Measure from the bottom of the tank to the bottom of the fitting.

11.3.7. Proper backfilling is required to provide necessary support for the tank.

11.3.8. Place the first 12" lift of approved backfill material evenly around the tank. From the edge of the hole or the top of an adjacent tank, push the backfill in place by using a probe long enough to reach beneath the tank. Work the backfill material under the entire length of the tank between and around ribs and endcaps, eliminating all voids, so the tank is fully supported (see Figure 11-3).

Figure 11-3



NOTICE

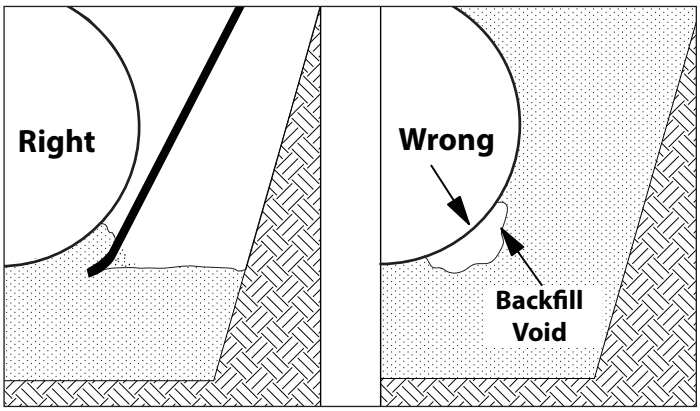
Do not strike the tank with the probe or tank damage may result.

11.3.9. Eliminate all voids by using a long handled probe to push backfill:

11.3.9.1. Completely beneath tank bottom.

11.3.9.2. Completely between the 5 o'clock and 7 o'clock positions along the entire length of the tank between and around all ribs and endcaps. It is critical to tank performance that this area offers full support under the tank and end caps (see Figure 11-4).

Figure 11-4



11.3.10. Repeat this process with a second 12" lift.

11.3.11. After completion of second lift, backfill can be brought to tank top without additional handwork.

11.3.12. Special Instructions for a wet hole installation:

11.3.12.1. Water level in the excavation should be maintained at lowest practical level by using pumps.

⚠CAUTION

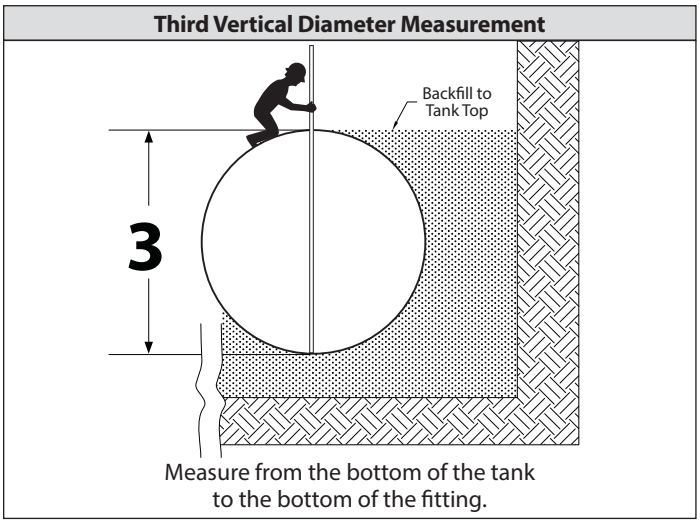
Keep tank vented to prevent pressurization of tank when adding ballast. As the tank nears full, reduce the fill rate to prevent pressurization or tank damage may occur. This may result in personal injury or property damage.

11.3.12.2. Ballast the tank if ground water cannot be lowered. Ballast the tank per section 10.

11.3.13. Backfill to the tank top.

11.3.14. Take the Third Vertical Diameter Measurement and record the value on the Tank Installation Checklist and verify measurement A does not exceed the value in Table 11-1 (see Figure 11-6).

Figure 11-6



NOTICE

Do not ballast tank until backfill is even with tank top or tank damage can occur.

11.3.15. After backfill is even with tank top, CSI recommends filling all tank compartments with ballast to minimize chance of buoyancy.

11.3.16. Additional information on alternate installation techniques is available. Refer to Supplemental Documents (Section 21) for additional information.

11.4. Backfill To Subgrade

11.4.1. When the tank has been lowered into the excavation and all testing, backfilling, venting and piping has been completed; add the remaining backfill material to subgrade.

11.4.2. Approved pea gravel or crushed stone must be used to backfill the tank a minimum of 75% up the side wall of the tank(s).

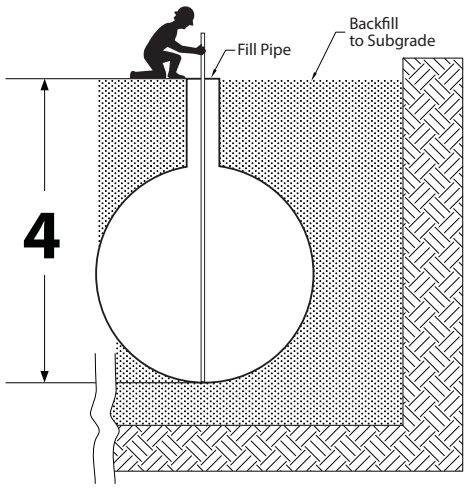
11.4.3. If alternative smaller or finer backfill material is used to subgrade, geotextile fabric is required. Refer to Supplemental Documents (Section 21) for additional information.

11.4.4. Once the tank has been backfilled to subgrade, before placement of concrete pad, take the fourth vertical diameter measurement.

11.4.5. Take the Fourth Vertical Diameter Measurement and record the value on the Tank Installation Checklist (see Figure 11-7).

Figure 11-7

Fourth Vertical Diameter Measurement

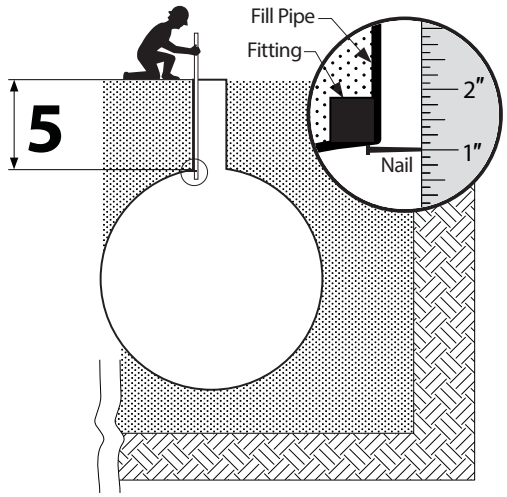


Measure from the bottom of the tank to the top of the fill pipe.

11.4.6. Take the Fifth Vertical Diameter Measurement and record the value on the Tank Installation Checklist (see Figure 11-8).

Figure 11-8

Fifth Vertical Diameter Measurement



This measurement is taken by:

1. Driving a nail into the 1" point at a right angle to the gauge stick.
2. Lower the gauge stick down the fill pipe far enough to extend below the bottom of the fitting.
3. Lift the gauge stick until the nail catches on the lip of the fitting.
4. Read the measurement at the top of the fill pipe.
5. Subtract 1" to allow for the point where the nail is in the gauge stick.

11.4.7. The inner diameter measurement is calculated by subtracting the "Fourth Vertical Diameter Measurement" and "Fifth Vertical Diameter Measurement".

11.4.8. After the final measurement has been recorded, complete the Vertical Diameter Measurement section of the Tank Installation Checklist. Verify the values in Table 11-1 have not been exceeded.

11.4.9. If the final deflection measurement exceeds the values in Table 11-1 you should stop the installation, prior to pouring the concrete pad, and immediately contact CSI Tank Technical Support for directions.

12. ADDING TANKS AT EXISTING LOCATIONS

NOTICE

Avoid surface loads that may result in a collapse of the excavation or disturb any existing tanks.

12.1. Additional tanks may be installed at existing locations using one of the following methods:

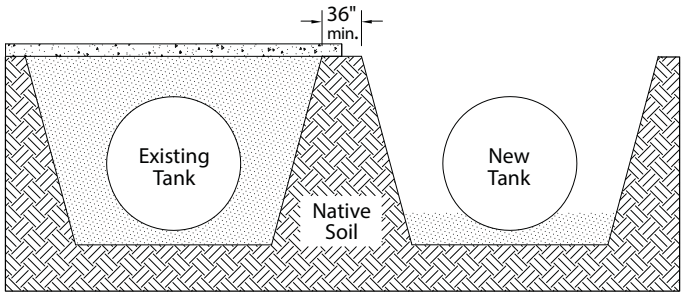
12.2. Preferred Method

12.2.1. Install a new tank in a separate hole at least 36" from the original excavation.

12.2.2. Follow procedures outlined in this Installation Manual.

12.2.3. Maintain a minimum 36" at grade of native soil between existing and new installation (see Figure 12-1).

Figure 12-1



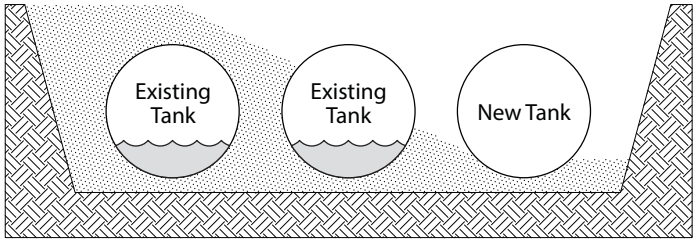
12.3. Alternate Method For Dry Hole Excavation

12.3.1. Lower ballast in existing tanks to less than 25% capacity.

12.3.2. Remove the surface slab.

12.3.3. Enlarge the excavation for the new tanks, leaving as much backfill as possible around the existing tanks (see Figure 12-2).

Figure 12-2



12.3.4. Install shoring, if necessary, to make sure that existing tanks do not move and sufficient backfill remains.

12.3.5. Install all tanks following the instructions outlined in this manual.

12.3.6. Follow and complete the Tank Installation Checklist for all new and existing tanks.

13. PIPING & BOTTOM SUMP CLEARANCES

NOTICE

All connections to the tank must be flexible. Provisions must be made to accommodate movement and misalignment between the piping and the tank. Failure to do this may damage the tank or surrounding property.

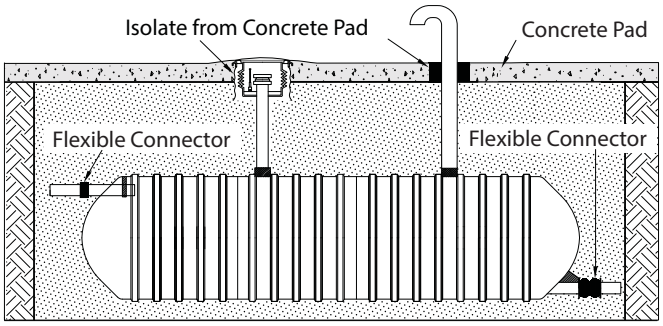
13.1. Tanks with Bottom Sumps / Fittings

13.1.1. To install a tank with a bottom sump or fitting, the excavation and backfill must be modified as follows. Refer to Supplement Documents (Section 21) for additional information:

13.2. External Piping

13.2.1. Isolate the piping from the concrete pad (see Figure 13-1).

Figure 13-1



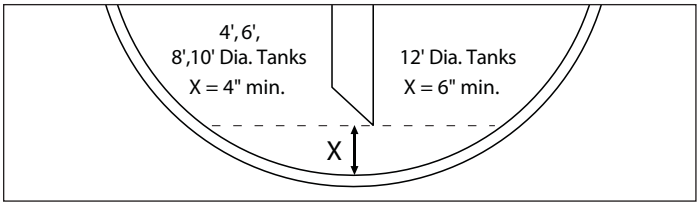
13.2.2. A flexible connector must be directly installed on all tangentially mounted fittings, nozzle or pipe. The flexible connector must allow for ½" of offset, angular, expansion, and compression movement. Refer to Supplemental Documents (Section 21) for additional information.

13.2.3. Nozzle bolt torque can be found in Flexible Connector supplemental document. Refer to Supplemental Documents (Section 21) for additional information.

13.2.4. Take precaution during construction to make sure no damage occurs to the exposed pipe(s).

13.2.5. Internal piping must terminate a minimum of 4" from tank bottom for 4', 6', 8', and 10' diameter tanks and 6" from the bottom for 12' diameter tanks to allow for tank deflection (see Figure 13-2).

Figure 13-2



14. VENTING

14.1. All primary tanks and compartments that contain product must be vented at all times, except as defined during pre-installation testing.

14.2. Tanks are designed for operation at atmospheric pressure (except for use with vapor recovery systems provided the pressure or vacuum does not exceed 1 psig).

14.3. For tanks with inlet or outlet piping that will result in pressure at the tank top, the pressure should be limited to 1 psig.

14.4. The tank's venting system must be adequately sized to ensure that the pressure or vacuum at the tank top will not exceed 1 psig at the tank top at all times, including when filling and emptying the tank.

14.5. Annular space vents must be independent of tank vents.

14.6. For hydrostatically monitored double-wall tanks, the annular space must be vented at all times.

14.7. For dry monitored double-wall tanks, annular space does not need to be vented.

15. FILLING TANKS

NOTICE

Pressurized product deliveries may pressurize the tank and result in tank damage.

15.1. If the delivery vehicle uses pumps to fill the tank:

15.1.1. Install positive shut-off equipment in the lines and on the truck to prevent the tank from being overfilled.

15.1.2. Pressurization from overfilling will damage the tank, even if the tank vent is unrestricted.

15.2. Do not use a ball float valve for overfill protection.

16. MANWAYS

⚠WARNING

Do not enter tank unless following OSHA guidelines for confined space entry. Failure to follow OSHA guidelines could result in death or serious injury.



ASPHYXIATION **FIRE** **EXPLOSION**

16.1. The load bearing capacity for a standard 22" manway installed is 1,200 lbs. for single-wall tanks and 2,400 lbs. for double-wall tanks.

16.2. All 30" and 36" manways have a load bearing capacity of 2,400 lbs.

16.3. Do not exceed 50 ft./lb. torque during bolt tightening or manway flange damage may occur.

17. TANK ANNULAR SPACE MONITORING

17.1. Hydrostatic Monitoring

17.1.1. Because of its superior leak detection capability, Containment Solutions recommends the Hydrostatic Tank Monitor for continuous monitoring of the annular space. However, the tank owner or the tank owner's representative is responsible for selecting the monitoring system.

17.1.2. Tanks with hydrostatic monitoring systems normally arrive with monitoring fluid installed in the annular space and some fluid in the reservoir.

17.1.2.1. After installation, the fluid level in the reservoir must be filled to the proper level.

17.1.2.2. Additional monitoring fluid is supplied with the tank for this purpose.

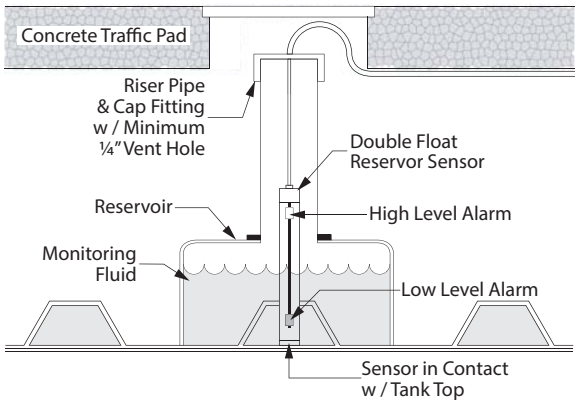
NOTICE

Hydrostatic monitoring space between the inner and outer tank must be vented to the atmosphere. If unvented, pressure buildup can cause tank damage.

17.1.3. Vent annular space with a minimum ¼" hole at riser top.

17.1.4. When installing a double float sensor, the bottom of the sensor must be in contact with the tank top (see Figure 17-1).

Figure 17-1



⚠WARNING

Always wear safety glasses and protective clothing when handling monitoring fluid. Monitoring fluid spillage may cause surfaces to be slippery.
Refer to MSDS sheet for additional information.

17.1.5. The standard monitoring fluid is a calcium chloride in water with a biodegradable green tint.

17.1.6. Add brine to the reservoir until the fluid level matches the following table values in Table 17-1:

17.1.7. During or after, if the reservoir sensor indicates a high or low level alarm, it is necessary to first determine that the alarm is not the result of an incorrect initial fluid level setting.

17.1.7.1. Remove the sensor.

17.1.7.2. Test the sensor for proper operation.

17.1.7.3. Check that the float sensor is positioned on the tank top. The bottom float should be within 2" of the bottom and floats are spaced a minimum of 11" apart.

17.1.7.4. Reset the fluid level in the reservoir by adding or removing fluid as indicated in Table 17-1.

17.1.7.5. Reinstall the sensor.

17.2. Note: If a second alarm occurs, additional instructions for setting the brine level are available from Containment Solutions Field Services.

TABLE 17-1

Tank Diameter & Capacity	Reservoir Fluid Level Measurement		
	Tank is Empty	Tank is Half Full	Tank is Full
4' (1M and less)	5¼"	7"	8¾"
4' (over 1M)	4¼"	4¾"	5"
6' (6M and less)	4"	4¾"	5½"
6' (over 6M)	3½	4¾"	6"
8' (6M and less)	4¼"	4¾"	5¼"
8' (over 6M)	4¼"	5"	6"
10' (12M and less)	4½"	5¼"	6"
10' (13M thru 20M)	5¼"	6½"	8"
10' (21M thru 35M)	3¾"	6½"	9½"
10' (36M thru 50M)	4"	5¾"	7½"
12' (25M and less)	4"	6½"	9¼"
12' (26M thru 40M)	4¼"	5¾"	7¼"
12' (41M thru 50M)	3½"	5¾"	8"

17.3. Dry Annular Space Monitoring with Sensor

17.3.1. Consult monitoring equipment manufacturer for proper installation.

17.3.2. When liquid or vapor sensors are used, the tank may be sloped at time of installation.

17.3.3. If tank is sloped, place tank so that the lowest elevation is at monitoring end.

17.3.4. Calibration charts are designed for level tank installation. Sloped tanks will affect the tank calibration chart accuracy.

17.3.5. Use a wire puller to position sensor at the tank bottom.

17.3.6. For ease of installation insert the sensor in the tank cavity before installing the monitoring riser pipe to grade. Use a minimum 4" riser to grade for removal and replacement of sensor.

17.3.7. CSI recommends a permanent pull cable be installed and accessible at grade to facilitate periodic sensor inspections.

17.3.8. For dry monitored double-wall tanks, annular space does not need to be vented.

17.4. Dry Annular Space Vacuum or Air Pressure Monitoring

17.4.1. Consult monitoring equipment manufacturer for proper installation.

17.4.2. Maximum vacuum for continuous monitoring is 5 psig utilizing an approved vacuum monitoring system with a vacuum make-up pump.

17.4.3. Maximum pressure for continuous air pressure monitoring is 3 psig utilizing an approved monitoring system with a make-up pump. Ensure the system is designed to prevent over pressurization of the annular space as tank damage may occur.

18. CONTAINMENT COLLARS, TANK SUMPS & TANK RISERS

NOTICE

In freezing conditions, protect collar and sump from water accumulation. Freezing water may cause damage.

NOTICE

Secondary containment collar must be continuously monitored for potential spills or leaks.

18.1. CSI single and double-wall containment collars are factory installed to the tank top to provide a means of secondarily containing leaks from pumps and piping.

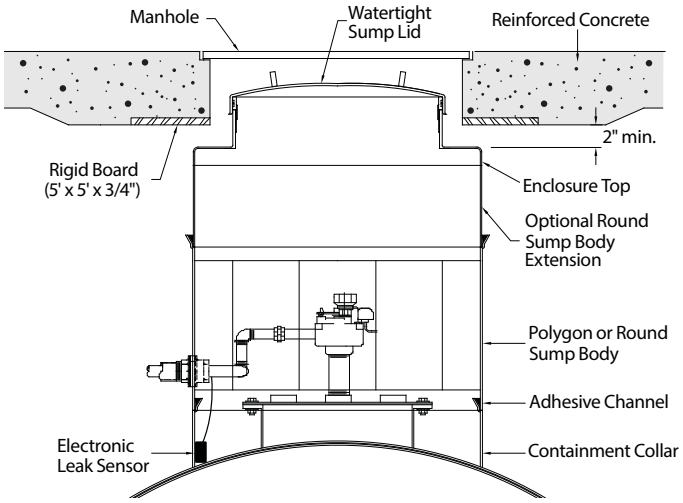
18.2. CSI tank sumps are designed to provide a watertight connection to the tank collar utilizing an adhesive joint.

18.3. All Tank Collars And Sumps:

18.3.1. Must be continuously monitored for leaks using an electronic leak monitoring sensor.

18.3.2. Must be isolated from direct traffic loading (see Figure 18-1).

Figure 18-1



18.4. Single and Double-Wall Tank Sump Installation Instructions are available. Refer to Supplemental Documents (Section 21) for additional information.

18.5. Collar Test Instructions

NOTICE

DO NOT pressure test sump. If applying vacuum, DO NOT apply more than 25 inches water vacuum to sump enclosure or damage may occur.

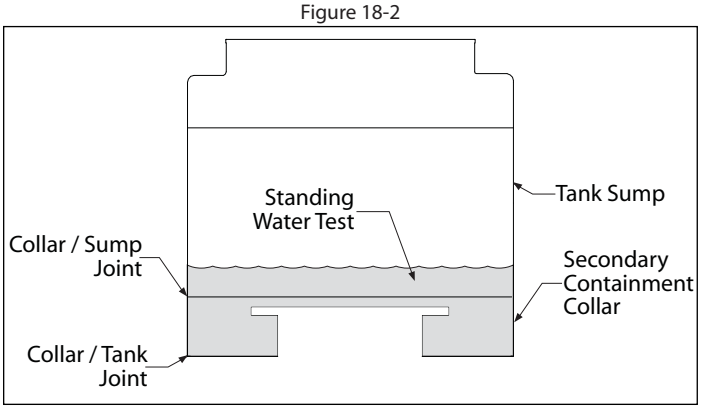
18.5.1. Fill sump with water at least 4" above highest joint or penetration.

18.5.2. Record the liquid level.

18.5.3. Wait a minimum of 1 hour.

18.5.4. Re-measure and record the liquid level. A liquid change of more than ⅛" (0.125") indicates a possible leak (see Figure 18-2).

Figure 18-2



18.5.5. Visually inspect for leaks in the following locations:

- All penetrations
- All fittings
- At each sump joint
- Where collar connects to tank wall

18.5.6. Test liquids must be disposed of properly.

18.5.7. Initial jobsite testing:

18.5.7.1. At installation, the contractor must leak test this collar and sump before the tank installation is complete.

18.6. Access Risers (Non Petroleum Tanks)

18.6.1. Access Riser Installation Instructions are available. Refer to Supplemental Documents (Section 21) for addition information.

19. OPERATING GUIDELINES

19.1. General

19.1.1. The tank installation checklist, these instructions, and any correspondence related to the tank installation must be retained by the tank owner. The checklist will be required and must be provided to CSI when making a warranty claim.

19.1.2. For the life of the installation, the installed tank must comply with NFPA (30, 30A, and 31) and all applicable Federal, State, Local or Provincial codes and regulations.

19.1.3. It is the responsibility of the tank owner/ operator to follow these instructions and operating guidelines and all limitations as stated in the limited warranties in effect at time of delivery.

19.1.4. The limited warranty in effect at the time of tank delivery will apply and is available online at www.containmentsolutions.com.

19.2. Fiberglass Tanks Intended Use

19.2.1. Each tank is designed and manufactured to store products for the intended use as outlined in the applicable limited warranty. Storing products that were not disclosed to CSI in writing prior to the manufacture of the tank may damage the tank and could result in tank failure and/or damage to surrounding property.

19.2.2. The temperature of stored product must not exceed the temperature limits defined in the applicable limited warranty.

19.2.3. Product delivery temperatures must not exceed the temperature limits defined in the applicable limited warranty.

19.2.4. Ensure that downward forces from nearby structures are not transmitted to existing tanks (refer to NFPA 30 for additional details).

19.2.5. Additional tanks may be installed adjacent to existing tanks by using the methods described in these installation instructions.

19.3. Confined Space Entry

⚠WARNING

Do not enter tank unless following OSHA guidelines for confined space entry. Failure to follow OSHA guidelines could result in death or serious injury.



ASPHYXIATION **FIRE** **EXPLOSION**

19.3.1. Tanks, containment sumps, manway extensions and access risers are confined spaces.

19.3.2. The tank owner should not allow anyone other than properly trained and equipped personnel to enter an underground tank.

19.3.2.1. Proper permits and industry accepted minimum standards must be followed before anyone can enter a sump or riser.

19.3.2.2. Contact Containment Solutions Field Services at (800) 822-1997 if repairs or modifications are required.

19.3.3. Tank entry by unqualified personnel can lead to fire, explosion, asphyxiation and/or death. Manways and access risers are for use by qualified personnel with proper training and safety equipment.

19.3.4. Do not attempt to repair or modify your tank. Any repairs or modifications will void the tank limited warranty.

19.3.5. If tank entry is required for tank repairs, modifications or inspections, contact Containment Solutions Field Services at (800) 822-1997.

19.4. Filling / Venting Tanks (General)

⚠WARNING

Over-pressurizing the tank could result in tank failure and could result in death or serious injury.

NOTICE

Pressurized product deliveries may pressurize the tank and result in tank damage.

19.4.1. Underground tanks are designed to operate at atmospheric pressure. Tanks may be damaged by pressurized product deliveries or situations in which hydrostatic head pressure exceeds tank design safety factors.

19.4.2. All products must be gravity fed into the tank unless positive shut-off equipment is installed in the lines and on the truck.

19.4.3. If the delivery vehicle uses pumps to fill the tank, precautions must be taken as outlined in the "Filling Tanks" section of this manual.

19.4.3.1. Product delivery from vehicles using pressure in the ullage is not allowed.

19.4.4. The tank's venting system must be adequately sized to ensure that atmospheric pressure is maintained at all times, including when filling and emptying the tank.

19.4.4.1. For tanks with inlet or outlet piping that will result in pressure at the tank top, the pressure should be limited to 1 psig.

19.5. For UL/ULC tanks, The Petroleum Equipment Institute has published several recommended practices (PEI/RP900 and PEI/RP1200) that address proper maintenance, inspection and testing of overfill prevention equipment. Tank owners should obtain a copy of the documents at http://www.pei.org. In addition, the Fiberglass Tank and Pipe Institute has published a white paper on the adverse effects of using vent restriction devices such as ball-float valves and the unintended consequences that may occur see http://www.fiberglasstankandpipe.com.

19.6. The owner must make sure the tank is properly vented at all times as described in the venting section of this manual. Vent piping should be properly installed and unobstructed.

19.7. Do not use ball float valve for overfill protection.

19.8. For tanks with vapor recovery systems, the pressure or vacuum cannot exceed 1 psig.

19.9. It is strongly recommended that the tank be gravity filled and that the owner regularly inspect the automatic shut off device or vent restriction device for proper operation.

19.10. Proper grounding of the drop tube/fill line is important to prevent static discharge during filling.

19.11. If flooding may occur, precautions should be taken to prevent tank float and equipment damage. See EPA "Underground Storage Tanks Flood Guide". See Ballasting section in these instructions should ballasting tanks be required.

19.12. Containment Sumps, Manway Extensions, and Access Risers

19.12.1. Tank owner must leak test the collar and containment sump after any damage, repairs, modifications or to meet regulatory requirements.

19.12.2. UL/ULC sumps must be continuously monitored with an electronic leak detector for potential spills or leaks.

19.12.3. Gaskets are consumable products which will have to be replaced periodically or when it shows a leak during a tightness test.

20. CONVERSION FORMULAS

20.1. Use this as a guide if a dimension does not have a metric conversion printed.

LENGTH

mm = millimeters

- 1" = 25.4 mm
- 1' = 304.8 mm

WEIGHT

kg = kilogram

- 1lb = 0.454 kg

PRESSURE

kPa = kilopascals

- 1 psi = 6.894 kPa

CAPACITY

L = liters

- 1 gal = 3.785 L

21. SUPPLEMENTAL DOCUMENTS

21.1. Supplemental documents, which may apply to specific installations and / or conditions, are available upon request from Containment Solutions Technical Support.

- Single-Wall Tank Sump Installation Instructions (Pub. No. INST 6030)
- Double-Wall Tank Sump Installation Instructions (Pub. No. INST 6034)
- Access Riser Installation Instructions w/ Adhesive Channels (Pub. No. INST 6056)
- Standard Hold Down Strap Anchor System (Pub. No. INST 6062)
- Split Strap Anchor System (Pub. No. INST 6063)
- Wire Rope over Tank Top (Pub. No. INST 6047)
- Fiberglass Tanks Shipping into Canada Installation Instructions (Pub. No. INST 6043-CAN)
- Urea DEF Installation Instructions (Pub. No. INST 6052)
- Triple-Wall Tank Installation Instructions (Pub. No. INST 6045)
- NYC Special Installation Instructions (Pub. No. INST 6008)
- Fiberglass Oil/Water Separator Tank Installation and Start-Up Instructions (Pub. No. OWS 2013)
- Alternate Backfill Above Tank Top Installation Instructions (Pub. No. INST 6014)
- Berm Installation Instructions (Pub. No. 6022)
- Bottom Sump Installation Instructions (Pub. No. INST 6044)
- Flexible Connector Specification (SPEC 9005)
- Brine Monitoring Fluid MSDS Sheet (Pub. No. 15002)
- Lifting Tanks with Slings (Pub. No. 6021)

Appendix A - Anchor Chart (4', 6', 8' Diameter Tanks)

Anchor Chart

Minimum burial depth to achieve 1.2 safety factor against flotation assuming worst case conditions of water to grade and the tank empty. Assumes multiple tank installation.

	Tank Diameter & Nominal Capacity in Gallons (Including all Compartments)	Space Between Tanks	# of Anchor Straps	# of Sumps or Risers (Backfill to Grade No Traffic / Backfill with 6" Concrete Traffic Pad)				
				0	1	2	3	4
4' Diameter Tanks	up to 1,000 w/ 12"x12" DM	24"	2	24" / 24"	33" / 24"	-	-	-
	up to 1,000 w/ 8" Pad	24"	2	24" / 24"	33" / 24"	-	-	-
	up to 1,000 No Mech	18"	0	29" / 26"	58" / 53"	-	-	-
	1,100 - 1,500 w/ 12"x12" DM	24"	2	24" / 24"	33" / 24"	81" / 68"	-	-
	1,100 - 1,500 w/ 8" Pad	24"	2	24" / 24"	45" / 38"	81" / 68"	-	-
	1,100 - 1,500 No Mech	18"	0	29" / 26"	51" / 46"	74" / 68"	-	-
	1,600 - 2,000 w/ 12"x12" DM	24"	4	24" / 24"	35" / 26"	35" / 26"	-	-
	1,600 - 2,000 w/ 8" Pad	24"	4	24" / 24"	35" / 26"	35" / 26"	-	-
	1,600 - 2,000 No Mech	18"	0	30" / 27"	46" / 41"	57" / 52"	-	-
6' Diameter Tanks	up to 4,000 w/ 12"x12" DM	24"	2	28" / 24"	43" / 38"	52" / 46"	-	-
	up to 4,000 w/ 8" Pad	24"	2	28" / 24"	43" / 38"	52" / 46"	-	-
	up to 4,000 No Mech	18"	0	44" / 41"	62" / 58"	73" / 69"	-	-
	4,100 - 6,000 w/ 12"x12" DM	24"	4	27" / 24"	33" / 29"	36" / 31"	65" / 57"	-
	4,100 - 6,000 w/ 8" Pad	24"	4	26" / 24"	31" / 28"	34" / 28"	65" / 57"	-
	4,100 - 6,000 No Mech	18"	0	46" / 43"	59" / 55"	62" / 58"	75" / 71"	-
	6,100 - 10,000 w/ 12"x12" DM	24"	6	29" / 26"	33" / 30"	36" / 32"	41" / 36"	45" / 39"
	6,100 - 10,000 w/ 8" Pad	24"	6	29" / 26"	33" / 30"	36" / 32"	41" / 36"	45" / 39"
	6,100 - 10,000 No Mech	18"	0	47" / 44"	56" / 52"	57" / 54"	64" / 60"	68" / 64"
8' Diameter Tanks	up to 7,000 w/ 12"x12" DM	24"	2	36" / 32"	47" / 43"	53" / 48"	-	-
	up to 7,000 w/ 8" Pad	24"	2	36" / 32"	47" / 43"	53" / 48"	-	-
	up to 7,000 No Mech	18"	0	58" / 55"	73" / 69"	82" / 78"	-	-
	7,100 - 12,000 w/ 12"x12" DM	24"	4	39" / 35"	45" / 41"	47" / 43"	65" / 60"	65" / 60"
	7,100 - 12,000 w/ 8" Pad	24"	4	38" / 35"	42" / 39"	42" / 39"	65" / 60"	65" / 60"
	7,100 - 12,000 No Mech	18"	0	61" / 58"	72" / 68"	76" / 72"	84" / 81"	NA
	13,000 - 16,000 w/ 12"x12" DM	24"	6	41" / 38"	46" / 42"	47" / 43"	52" / 47"	68" / 61"
	13,000 - 16,000 w/ 8" Pad	24"	6	38" / 35"	42" / 39"	42" / 39"	52" / 47"	68" / 61"
	13,000 - 16,000 No Mech	18"	0	62" / 59"	71" / 68"	73" / 70"	80" / 76"	84" / 81"
	17,000 - 20,000 w/ 12"x12" DM	24"	8	42" / 38"	46" / 42"	47" / 43"	50" / 42"	52" / 48"
	17,000 - 20,000 w/ 8" Pad	24"	8	34" / 31"	38" / 35"	41" / 37"	41" / 37"	41" / 37"
	17,000 - 20,000 No Mech	18"	0	63" / 60"	70" / 66"	71" / 67"	76" / 72"	79" / 75"

Contact Tank Technical Support for alternate anchoring methods.

Note: DM = Concrete Deadman Anchors
Pad = Concrete anchor pad under tank
No Mech = No mechanical anchoring
NA = Not allowed

Appendix A - Anchor Chart (10', 12' Diameter Tanks)

Anchor Chart

Minimum burial depth to achieve 1.2 safety factor against flotation assuming worst case conditions of water to grade and the tank empty. Assumes multiple tank installation.

	Tank Diameter & Nominal Capacity in Gallons (Including all Compartments)	Space Between Tanks	# of Anchor Straps	# of Sumps or Risers (Backfill to Grade No Traffic / Backfill with 6" Concrete Traffic Pad)				
				0	1	2	3	4
10' Diameter Tanks	up to 10,000 w/ 18"x8" DM	36"	3	44" / 39"	50" / 44"	57" / 51"	-	-
	up to 10,000 w/ 8" Pad	24"	3	33" / 29"	39" / 35"	57" / 51"	-	-
	up to 10,000 No Mech	18"	0	78" / 75"	NA	NA	-	-
	10,000 - 18,000 w/ 18"x8" DM	36"	4	47" / 43"	53" / 49"	55" / 50"	76" / 70"	80" / 75"
	10,000 - 18,000 w/ 8" Pad	24"	4	47" / 43"	53" / 49"	55" / 50"	76" / 70"	80" / 75"
	10,000 - 18,000 No Mech	18"	0	83" / 80"	NA	NA	NA	NA
	19,000 - 23,000 w/ 18"x8" DM	36"	6	44" / 40"	49" / 45"	51" / 47"	62" / 60"	72" / 67"
	19,000 - 23,000 w/ 8" Pad	24"	6	41" / 37"	51" / 47"	51" / 47"	62" / 60"	72" / 67"
	19,000 - 23,000 No Mech	18"	0	84" / 81"	NA	NA	NA	NA
	24,000 - 35,000 w/ 18"x8" DM	36"	8	51" / 47"	57" / 53"	70" / 66"	70" / 66"	70" / 66"
	24,000 - 35,000 w/ 8" Pad	24"	8	51" / 47"	57" / 53"	69" / 65"	69" / 65"	69" / 65"
	24,000 - 35,000 No Mech	18"	0	84" / 81"	NA	NA	NA	NA
	36,000 - 40,000 w/ 18"x8" DM	36"	10	49" / 46"	54" / 51"	59" / 55"	60" / 56"	60" / 56"
	36,000 - 40,000 w/ 8" Pad	24"	10	47" / 46"	54" / 51"	59" / 55"	62" / 58"	65" / 60"
	36,000 - 40,000 No Mech	18"	0	84" / 81"	NA	NA	NA	NA
12' Diameter Tanks	up to 25,000 w/ 18"x8" DM	36"	8	59" / 56"	65" / 61"	66" / 63"	72" / 68"	76" / 72"
	up to 25,000 w/ 8" Pad	24"	8	43" / 40"	54" / 49"	62" / 58"	62" / 58"	62" / 58"
	up to 25,000 No Mech	24"	0	80" / 77"	NA	NA	NA	NA
	26,000 - 35,000 w/ 18"x8" DM	36"	10	62" / 59"	67" / 63"	68" / 64"	71" / 68"	75" / 71"
	26,000 - 35,000 w/ 8" Pad	24"	10	49" / 46"	63" / 59"	63" / 59"	63" / 59"	66" / 62"
	26,000 - 35,000 No Mech	24"	0	83" / 80"	NA	NA	NA	NA
	36,000 - 45,000 w/ 18"x8" DM	36"	12	64" / 61"	68" / 64"	68" / 65"	72" / 68"	74" / 71"
	36,000 - 45,000 w/ 8" Pad	24"	12	53" / 50"	63" / 59"	63" / 59"	67" / 63"	67" / 63"
	36,000 - 45,000 No Mech	24"	0	84" / 81"	NA	NA	NA	NA
	46,000 - 50,000 w/ 18"x8" DM	36"	14	64" / 61"	68" / 65"	69" / 65"	72" / 68"	73" / 70"
	46,000 - 50,000 w/ 8" Pad	24"	14	49" / 46"	63" / 59"	63" / 59"	63" / 59"	63" / 59"
	46,000 - 50,000 No Mech	24"	0	84" / 81"	NA	NA	NA	NA

Contact Tank Technical Support for alternate anchoring methods.

Note: DM = Concrete Deadman Anchors
Pad = Concrete anchor pad under tank
No Mech. = No mechanical anchoring
NA = Not allowed

Standard Tank Sizes

The following table represents the most popular tank sizes at the various tank diameters.

Tank Diameter	Capacity		Length		Single-Wall Weight		Double-Wall Weight*	
	Nominal	Liters	Feet/Inch	Millimeter	Pound	Kilogram	Pound	Kilogram
4'	600 gal	2,297 L	7' 3"	2,210	320	145	975	442
4'	1,000 gal	3,661 L	11' 1"	3,378	400	181	1,235	560
6'	2,500 gal	10,191 L	13' 9"	4,191	1,300	589	2,650	1,202
6'	3,000 gal	12,594 L	16' 9"	5,105	1,500	680	3,000	1,361
6'	4,000 gal	15,001 L	19' 9"	6,020	1,650	748	3,550	1,610
6'	5,000 gal	19,007 L	24' 9"	7,544	2,000	907	4,350	1,973
6'	6,000 gal	23,418 L	30' 3"	9,220	2,300	1,043	5,100	2,313
8'	5,000 gal	18,749 L	16' 9"	5,105	1,800	816	3,600	1,633
8'	6,000 gal	22,350 L	19' 6"	5,944	2,050	930	4,050	1,837
8'	8,000 gal	29,547 L	25' 0"	7,620	2,450	1,111	5,000	2,268
8'	10,000 gal	36,748 L	30' 6"	9,296	2,900	1,520	5,950	2,699
8'	12,000 gal	43,945 L	36' 0"	10,972	3,350	10,947	7,050	3,198
8'	15,000 gal	55,126 L	44' 6"	13,576	4,500	2,041	9,350	4,241
10'	10,000 gal	38,874 L	20' 11"	6,388	3,600	1,633	7,500	3,402
10'	12,000 gal	44,999 L	23' 8"	7,226	4,000	1,814	8,600	3,901
10'	15,000 gal	57,244 L	29' 2"	8,903	4,750	2,155	10,500	4,762
10'	20,000 gal	75,614 L	37' 5"	11,417	6,100	2,767	13,550	6,146
10'	25,000 gal	94,636 L	46' 0"	14,021	7,550	3,425	17,100	7,756
10'	30,000 gal	113,003 L	54' 3"	16,535	8,750	3,969	20,400	9,253
10'	35,000 gal	132,025 L	62' 9"	19,139	10,050	4,559	24,350	1,1045
10'	40,000 gal	151,047 L	71' 4"	21,742	11,600	5,262	27,750	1,2587
12'	20,000 gal	75,974 L	27' 6"	8,382	8,600	3,900	21,500	9,755
12'	25,000 gal	96,588 L	34' 6"	10,516	10,400	4,717	26,100	11,840
12'	30,000 gal	114,257 L	40' 6"	12,344	11,900	5,398	30,350	13,770
12'	35,000 gal	134,378 L	47' 4"	14,427	13,850	6,282	35,100	15,925
12'	40,000 gal	152,047 L	53' 4"	16,256	15,400	6,985	39,050	17,715
12'	45,000 gal	172,452 L	60' 4"	18,390	17,200	7,802	43,650	19,800
12'	50,000 gal	189,841 L	66' 2"	20,168	18,850	8,550	47,650	21,615

*The double-wall weights are based on hydrostatically monitored tanks filled with monitoring fluid prior to delivery.

Tank Installation Checklist

For Fiberglass Underground Tanks

The tank installation checklist, these instructions, and any correspondence related to the tank installation must be retained by tank owner. This checklist will be required and must be provided to CSI when making a warranty claim.

Site Owner _____ **Date of Installation** _____

Site Address _____
Street City State Zip

Installing Contractor _____
Company Street City State Zip

General Site Procedures	Initial On Lines Below	
	Completed	**N/A**
1. Installation backfill material meets CSI specification (sieve analysis is attached).	_____	_____
Indicate which material you used: ☐ Pea Gravel		
☐ Crushed Stone		
☐ Other (CSI approval letter attached)		
2. Backfill above tank top.		
Indicate which material you used: ☐ Same backfill material as #1 above	_____	_____
☐ Geotextile and alternative material above tank top	_____	_____
3. Excavation and tank clearance meet requirements of Section 6.	_____	_____
4. Geotextile used to line excavation: ☐ Yes ☐ No	_____	_____
5. Indicate hole condition:		
☐ Dry hole (Water is not anticipated to reach tank – area is not subject to flooding)	_____	_____
☐ Wet hole (Excavation may trap water – area is subject to flooding)	_____	_____
6. Anchoring performed in accordance with installation instructions:	_____	_____
Indicate which method you used ☐ Deadmen		
☐ Anchor Pad		
☐ No mechanical anchoring		
7. Depth of backfill under tank _____ inches	_____	_____
8. All deflection measurements are recorded on reverse side.	_____	_____
9. Backfill placed in 12" lifts & probed as described in Section 11.	_____	_____
10. Tanks ballasted according to Section 10.	_____	_____
11. Tank burial depth complies with the requirements of Section 8.	_____	_____
12. Piping and bottom sump clearances according to Section 13.	_____	_____
13. All piping connections are flexible connections according to Section 13.	_____	_____

Tank Information Continued on next page

Installation was in accordance with Tank Installation Instructions (INST. 6001).

Owner Representative (Print Name)	Date	Contractor Representative (Print Name)	Date
Owner Representative (Signature)	Date	Contractor Representative (Signature)	Date

Tank Specific Information

	TANK NUMBER 1	2	3	4	5
14. Underwriter Laboratories label or tank serial number.					
15. Tank type.* (Indicate SW, DW, SW-OWS, or DW-OWS for each tank)					
16. Interstitial Monitor type.** (Indicate HYDRO, DRY, VAC or PRES for each tank)					
17. Tank capacity. (Indicate unit of measurement and record the capacities for each tank)		Select one:	☐ Gallons	☐ Liters	
18. Tank free of visual damage. (Document damage found and attach to this form)					
19. Monitoring fluid visible on inner or outer tank wall. (Indicate Yes or No for each tank)					
20. Pre-Installation air/soap test performed without leaks. Indicate which test in Section D you used per tank:					
21. Hydrostatically monitored tanks: Indicate Yes or N/A for each step completed per tank:					
• Sensor sits on tank top					
• Check and record monitoring-fluid level in reservoir					
• Annular space vented					
22. Vacuum monitored tanks: record vacuum date					
record vacuum level					

* **SW** = Single Wall Tank • **DW** = Double-Wall Tank • **SW-OWS** = SW Oil / Water Separator • **DW-OWS** = DW Oil / Water Separator

** **HYDRO** = Hydrostatic • **DRY** = Dry interstice space with probe • **VAC** = Vacuum • **PRES** = Positive Air Pressure

Tank Deflection Measurements

Measurement instructions are found in Section 11 of Tank Installation Instructions.

	1	2	3	4	5
1) First Vertical Diameter Measurement (Section 11, Figure 11-1)					
2) Second Vertical Diameter Measurement (Section 11, Figure 11-2)					
3) Third Vertical Diameter Measurement (Section 11, Figure 11-6)					
Measurement A - Tank deflection with backfill at tank top (subtract Measurement 3 from Measurement 1 above) **Refer to Table 11-1 for max. deflection values.**					
4) Fourth Vertical Diameter Measurement (Section 11, Figure 11-7)					
5) Fifth Vertical Diameter Measurement (Section 11, Figure 11-8)					
6) Calculate the final vertical diameter measurement (subtract Measurement 5 from Measurement 4 above)					
Measurement B - Tank deflection at subgrade (subtract Calculated Value (6) from Measurement 1 above) **Refer to Table 11-1 for max. deflection values.**					

NOTICE

If Measurement A or Measurement B exceeds the values shown in Table I-1, immediately contact Tank Technical Support prior to proceeding with the installation.

CSI Tank Technical Support: (800) 537-4730

TABLE 11-1

Tank Diameter	Maximum Deflection	
4'	½"	(12mm)
6'	¾"	(19mm)
8'	1¼"	(31mm)
10'	1½"	(38mm)
12'	1¾"	(44mm)

Technical Support
(800) 537-4730
Fax: (936) 756-7665

Field Service
(800) 822-1997
Fax: (814) 542-5020

Tank Sales
(877) 274-8265
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XERXES®
BY SHAWCOR

Installation Manual and Operating Guidelines

for Fiberglass Underground Storage Tanks







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Installation Manual and Operating Guidelines for Fiberglass Underground Storage Tanks

READ BEFORE INSTALLING TANK

Read all instructions, supplemental materials and operating guidelines before installation.

Compliance with the installation instructions and operating guidelines contained in this *Installation Manual and Operating Guidelines* (subsequently referred to as the *Installation Manual*) are necessary for the proper installation, maintenance, and use of our tanks and accessories. For proper installation of some tanks and accessories, it may also be necessary to consult select supplemental materials referenced in the **Introduction**. Failure to comply will void our obligations under the applicable limited warranty for the tank(s) and could result in death, serious injury, property damage or tank failure.

To Installer: Before installation, read and understand the *Installation Manual* and any applicable supplemental materials. After tank installation, deliver the *Installation Manual* with the completed Tank Installation Checklist at back of the *Installation Manual* to the tank owner.

To Owner: After installation, retain the limited warranty, the *Installation Manual* and checklist for future reference and follow all operating guidelines in the *Installation Manual*.

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INTRODUCTION

1. Before beginning the tank installation, read through the entire *Installation Manual and Operating Guidelines* (subsequently referred to as the *Installation Manual*) and any applicable supplemental materials. It is the responsibility of the owner, installer and operator to understand and follow all requirements contained in the *Installation Manual*.

2. Work must be performed according to standard industry practices applicable to tank installations and operations.

3. Work must comply with all codes, regulations and standards of appropriate governmental agencies, such as:

- construction, health, safety and environmental codes
- relevant US fire codes (for example, National Fire Protection Association standards 30, 30A and 31)
- relevant Canadian fire codes (for example, National Fire Code of Canada and provincial fire codes)
- industry standard practices (for example, PEI RP100, API RP1615)

4. For additional information, contact appropriate governmental agency storage-tank authorities, include fire or building departments, and environmental agencies.

5. For fuel tanks installed in Canada, the tank installer shall consult the authority having jurisdiction to ensure that the requirements of CAN/ULC S615, and all federal, provincial and local codes are met prior to installation.

6. The following safety designations will apply when reading the *Installation Manual*:

⚠WARNING Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury

⚠CAUTION Indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important but not hazard related. Failure to heed this notice could result in property damage.

7. Keep the *Installation Manual* available at the installation site to refer to safety procedures as needed.

⚠WARNING

Follow OSHA regulations and/or consult your local Canadian regulations concerning tank excavations, whichever are relevant. Collapse of excavation walls could result in death or serious injury.

8. Working in and around excavations is dangerous. Prior to beginning work at the site, the installer must follow any governmental or other codes and/or regulations applicable to excavations.

9. Careless activity or reckless operation of equipment can cause death, serious injury or property damage.

10. Governmental agency codes, regulations and standards always take precedence over our requirements.

11. No instructions or procedures presented in the *Installation Manual* should be interpreted so as to put at risk any person's health or safety, or to harm any property or the environment.

12. It is important to follow the procedures and instructions in the *Installation Manual* in order to safely and properly install our underground storage tank and accessories.

- Failure to follow these instructions will void our obligations under the limited warranty, could result in death, serious personal injury, property damage and/or tank failure.
- The presence of our representative does not relieve the installer of having sole responsibility for proper tank installation.

13. Our limited warranty applies only to a tank installed according to these instructions. Since we do not control the parameters of any installation, our sole responsibility in any installation is that presented in the limited warranty.

14. It is the responsibility of the owner and operator to always follow the operating guidelines set forth in our applicable limited warranty.

15. It is the responsibility of the owner and operator to always follow the operating guidelines set forth in **Section 9** of the *Installation Manual*.

16. It is the responsibility of the owner to retain the limited warranty and the *Installation Manual* provided with the tank for future reference. Go to xerxes.com for a copy of the current limited warranty.

17. Use the Tank Installation Checklist for all underground storage tanks throughout the installation process.

18. Record the relevant information for each tank installed on the Tank Installation Checklist. Additional copies are available at xerxes.com.

19. Tank installer must retain a copy of the completed Tank Installation Checklist and provide tank owner with a copy in order to facilitate any warranty claim.

20. Any variation to, or deviation from, the instructions in the *Installation Manual* must be approved in writing from us prior to the tank installation.

- All correspondence regarding any variances must be retained in the event of a future warranty claim.

21. For any questions regarding the interpretation of these instructions or for any other technical inquiries, contact eng.support@shawcor.com.

22. All contact information applicable to installation is found on the back cover of the *Installation Manual*.

USE OF TANK DATA CHARTS

23. The Tank Data Charts at the end of this document provide capacities, dimensions and weights of the most frequently sold one-compartment and multicompartment tanks in the US and Canada. For more details, see **Section 10.**

24. For information on additional tank sizes, contact eng.support@shawcor.com or go to xerxes.com.

25. For digital copies of Tank Data Charts and the Tank Installation Checklist, contact eng.support@shawcor.com or go to xerxes.com.

SUPPLEMENTAL MATERIALS

26. Go to xerxes.com to view tank installation training videos.

27. For supplemental materials pertaining to specific installations, contact eng.support@shawcor.com or go to xerxes.com.

28. For additional information on stormwater tank installations,contact eng.support@shawcor.com.

LIMITED WARRANTIES

29. Our applicable limited warranty contains operating guidelines and limitations that should be reviewed as applicable. Copies of our current limited warranties are found at xerxes.com.

1: PLANNING FOR INSTALLATION

1.1. GENERAL

1.1.1. This section of the *Installation Manual* contains information that you need to consider before a tank is delivered so that you are prepared to proceed with installation. This includes, but is not limited to, equipment needed for installation, backfill material selection, excavation requirements, tank anchoring options, taking diameter measurements, and onsite testing requirements.

1.1.2. The following list is to be used as a guide for equipment recommended for tank installation:

- excavation equipment capable of producing a level-bottom hole and placing backfill material at any point in the excavation
- suitable lifting equipment capable of lifting and placing the tanks and associated tank anchors
- spirit level
- transit or grade level
- 50-foot [15-meter] tape measure
- tamping rod(s)
- pipe wrenches and appropriate pipe joint compound
- a test manifold for each pressure-testable tank or compartment (reference **Figure 4-1**)
- source of pressurized air capable of 6 psig [40 kPa] or inert gas
- soap and water solution (during freezing conditions, a suitable solution such as windshield washer fluid may be added to the soap and water mixture)
- soft cloth, brush or hand-held pneumatic sprayer
- hand shovel
- lifting sling(s)
- soil compacting equipment (if necessary)

1.2. BACKFILL MATERIAL AND GEOTEXTILE

1.2.1. Tanks shall be installed using select rounded stones or crushed stones as primary backfill material. **See Backfill Sidebar** for detailed specifications.

1.2.2. Alternatively, tanks shall be installed using primary backfill vertically up to at least 75% of the tank diameter and secondary backfill above the primary backfill. This is commonly called a "split backfill" installation. **See Backfill Sidebar** for detailed specifications **and Figure 1-1.**

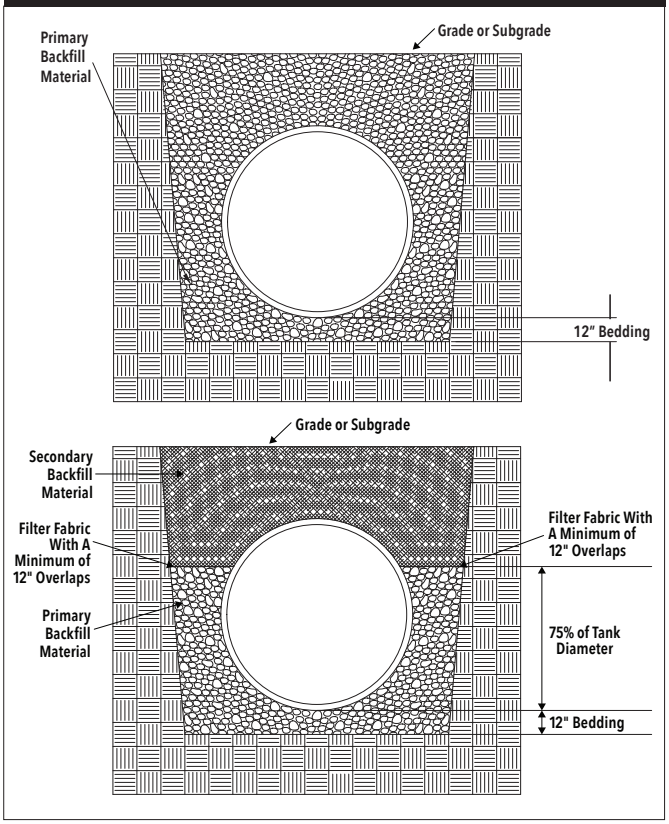
1.2.3. Using backfill material other than that specified here without prior written authorization from us will void our obligations under the applicable limited warranty.

NOTICE

Using other than specified backfill material could cause tank failure, or could result in damage to the tank and/or surrounding property.

1.2.4. It is recommended that the supplier of backfill material provide the tank installer and tank owner with written certification that the material conforms to ASTM C 33, ASTM D 448, AASHTO M 43, and any other applicable specifications.

Figure 1-1



1.2.5. If primary backfill material which meets these specifications is not available, contact eng.support@shawcor.com for information on alternate materials, installation instructions for alternate materials and the process for approval.

1.2.6. When used, secondary backfill material must meet the specifications detailed in the **Backfill Sidebar**.

1.2.7. Using geotextile fabric is considered good installation practice and using it in any installation is recommended, especially when the tank is installed in:

- areas with frequently changing groundwater conditions or areas subject to tidal fluctuations
- unstable soils such as those cited in **Section 1.3.5.3.**
- water conditions with silty in-situ soil.

1.2.8. The tank owner or the owner's technical representative is responsible for determining whether a geotextile or an alternate filtering technique is appropriate for a specific installation.

1.2.9. Geotextile helps preserve the integrity of the select backfill envelope that surrounds and supports the tank.

1.2.10. Geotextile fabric allows the passage of water in and out of the excavation but prevents the migration and mixing of in-situ soil and the select backfill material.

1.2.11. Polyethylene film is not considered an effective geotextile material because it may tear or degrade while in service.

1.2.12. If geotextile is used, install geotextile before placing bedding material.

1.2.13. Where both primary and secondary backfill are used, a layer of geotextile filter fabric must be installed over the entire surface of primary backfill material before secondary backfill is placed.

- All joints in the filter fabric must be overlapped a minimum of 12 inches [30 cm].
- Geotextile fabric must overlap onto the tank and excavation surface a minimum of 12 inches [30 ml].

1.3. EXCAVATION REQUIREMENTS

⚠WARNING

Consult OSHA's regulations, and/or applicable Canadian federal, provincial and municipal safety codes and operational regulations, whichever are relevant. Collapse of excavation walls could result in death or serious injury.

1.3.1. GENERAL

1.3.1.1. The installing contractor must take all necessary precautions in or near a tank excavation. These precautions should include but are not limited to the following:

- Locate and protect any utility installations near the excavation before opening the excavation.
- Secure the walls of the excavation.
- Take appropriate precautions to protect against exposure to hazardous vapors from the excavation.
- Avoid hazards associated with water accumulation in the excavation.
- Erect barricades, etc., to prevent unauthorized vehicle or pedestrian traffic.
- Inspect, a minimum of once a day, the excavation and surrounding area during the entire installation process.

1.3.1.2. For additional information on excavation, trenching and shoring safety practices, consult OSHA's regulations, and/or applicable Canadian federal, provincial and municipal safety codes and operational regulations, whichever are relevant.

⚠WARNING

Follow OSHA regulations or consult your local Canadian regulations concerning tank excavations, whichever are relevant. Collapse of excavation walls could result in death or serious injury.

1.3.1.3. The minimum clearance dimensions given in this section are important to the successful installation of a tank.

1.3.1.4. Additional clearances may be necessary due to regulations, safety requirements or operational requirements of governmental agencies. Follow all applicable regulations and safety practices.

1.3.1.5. For additional requirements and specifications, consult all codes and regulations of governmental agencies. See the Introduction for additional information.

1.3.2. EXCAVATION AND TANK LOCATION

1.3.2.1. We recommend that the tank owner seek the advice of a local foundation professional engineer to determine the proper placement of a tank excavation near any existing structure(s).

NOTICE

Improper placement of the excavation could result in damage to the tank and/or property damage.

BACKFILL SIDEBAR

GENERAL

1. Backfill is a critical part of a proper tank installation. The following are basic requirements for backfilling our tanks:

- Both primary and secondary backfill material is to be clean, free-flowing, and free of dirt, sand, large rocks, roots, organic materials, debris, ice and snow.
- No backfill material shall be frozen or contain lumps of frozen material any time during compaction or placement.

PRIMARY BACKFILL

2. Use coarse aggregate (rounded stones or crushed stones) as primary backfill material. See size requirements in drawings below.

3. Primary backfill material should be a mix of well-graded stones, generally conforming to the 6, 67, 7 and 8 sizes of ASTM's C33.

4. No more than 5% of this material can be small enough to pass through the #8 sieve.

5. Do not use materials like soft limestone, sandstone, sea shells or shale that break down over time.

SECONDARY BACKFILL
(used in split backfill installations)

6. Examples of acceptable secondary backfill material are:

- clean native backfill
- coarse sand
- gravel

7. Secondary backfill must be compact to achieve a minimum of 85% standard proctor density.

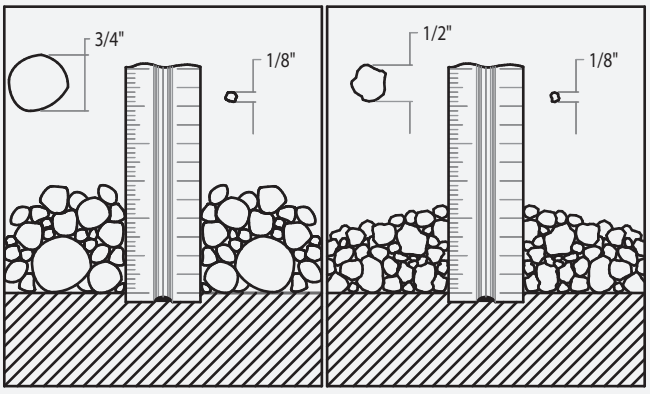
8. 100% of secondary backfill material must pass through a 1-inch [25-cm] sieve.

9. Secondary material must be installed in 12-inch [30-cm] to 24-inch [61-cm] lifts compatible with the compaction equipment used.

10. When using secondary backfill, consider potential frost-related problems to avoid frost heave.

11. Requirements of the piping, surface slab or roadway used may determine specifications for secondary backfill material and compaction above the filter-fabric layer.

12. Refer to applicable codes or standards for base course and sub-base course material and compaction requirements.



Rounded Stone Crushed Stone

1.3.2.2. The tank owner and/or the owner's technical representative is responsible for determining the proper placement of a tank excavation.

1.3.2.3. In general terms, the size of the excavation is determined by:

- the number of tanks to be installed
- the size of the tanks to be installed

1.3.2.4. The location of a tank can be affected by the location of nearby structures. When selecting a tank site, care must be taken to avoid undermining the foundations of existing structures or new buildings to be constructed. See **Figure 1-2**.

- Ensure that downward forces from loads carried by the foundations and supports of nearby structures (constructed before or after tank installation) are not transmitted to the tanks.

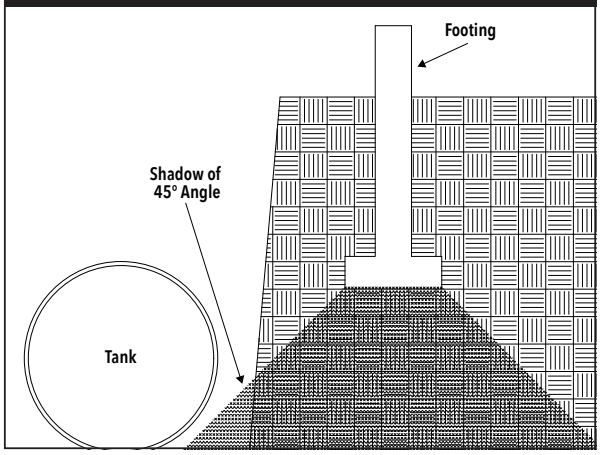
1.3.2.5. Typically, the way to check the placement of the tank in relationship to a nearby structure is to do the following:

- determine the depth of burial needed for the tank
- locate the footing of the structure to be considered
- determine the line that would fall into the ground from a 45-degree angle drawn downward from the corner(s) of the footing of the foundation that is closest to the tank

1.3.2.6. The tank must not fall within the "shadow" of the 45-degree angle line drawn from the foundation's footing. See **Figure 1-2**. If the tank would fall within this "shadow," do one of the following to ensure that the tank does not fall within the "shadow":

- move the tank away from the existing building
- move the foundation of the building to be constructed away from the tank
- deepen the footing of the planned building's foundation

Figure 1-2



1.3.3. DEPTH OF EXCAVATION

1.3.3.1. Typically, the depth of the excavation is determined by:

- groundwater conditions
- traffic at the site
- soft or uneven excavation base
- pipeline grade requirements and/or invert elevations
- codes and regulations

1.3.3.2. Groundwater must be considered if the level of water in the ground may rise above the bottom of the tank at any time during the life of the tank.

1.3.3.3. Traffic loads are considered to be loadings for highway vehicles up to H-20 or HS-20 as defined in the AASHTO Standard Specifications for Highway Bridges.

1.3.3.4. Excavations must allow for 12 inches [30 cm] of backfill between the bottom of the tank and the bottom of the excavation or the top of the anchor slab (or any other stabilizing materials used).

1.3.3.5. If either an anchor slab or other stabilizing material is used, allow additional depth in the excavation to accommodate their construction.

1.3.3.6. Typically, no additional depth of bedding is required for the use of a deadman anchoring system.

1.3.4. DEPTH OF COVER

⚠CAUTION

In both traffic and nontraffic installations, no truck or equipment loads are allowed over the tank until the backfill is at least at the depth of cover specified in Table 1-1 or Table 1-2, whichever is applicable. Failure to follow this caution could result in minor or moderate injury, and/or damage to the tank.

1.3.4.1. We recommend that every site be thoroughly evaluated for the potential of a rise in the local water table or of trapped water (a wet-hole condition). Sufficient overburden and/or an appropriate anchoring system must be present to offset buoyancy of the tank in such conditions.

NOTICE

Failure to provide sufficient overburden and/or an appropriate anchoring system could cause tank failure, or could result in damage to the tank and/or surrounding property.

1.3.4.2. The tank owner or the owner's technical representative is responsible for determining sufficient overburden and/or appropriate anchoring system.

1.3.4.3. The minimum depths of cover dimensions given here are important to the successful installation of a tank. They may not be sufficient to counteract buoyancy in wet-hole conditions.

Table 1-1

Depth of Cover Minimum Requirements for Fuel Tanks
No Traffic Options (US Installations)
• 24" [60 cm] backfill • 12" [30 cm] backfill + 4" [10 cm] reinforced concrete • 12" [30 cm] backfill + 6" [15 cm] asphalt
No Traffic Options (Canadian installations)
• 24" [60 cm] backfill
Traffic Options (US Installations)
• 36" [91 cm] backfill • 18" [46 cm] backfill + 6" [15 cm] reinforced concrete • 18" [46 cm] backfill + 8" [20 cm] asphalt
Traffic Options (Canadian installations)
• 39" [99 cm] backfill • 18" [46 cm] backfill + 6" [15 cm] reinforced concrete • 18" [46 cm] backfill + 8" [20 cm] unreinforced concrete
NOTE: These are NFPA 30 and 31 and National Fire Code of Canada requirements.

1.3.4.4. Additional depths of cover may be necessary due to safety requirements or operational requirements by governmental agencies.

⚠WARNING

In a nontraffic installation, ensure that the area above the tank is not subjected to traffic or other types of loads, which could cause damage to the tank, and could result in death or serious injury.

1.3.4.5. Fuel tanks must have a cover depth as shown in **Table 1-1**.

1.3.4.6. For fuel tanks, as a minimum, tank owner must comply with relevant fire codes – in the US, National Fire Protection Association (NFPA) 30 and 31; and in Canada, the National Fire Code of Canada and/or applicable local codes for fuel tanks. See **Table 1-1** for those requirements.

1.3.4.7. Tanks other than fuel tanks must have a cover depth as shown in **Table 1-2**.

Table 1-2

Depth of Cover Minimum Requirements for Tanks Other Than Fuel Tanks

No Traffic Options (All Installations)
• 12" [30 cm] backfill
Traffic Options (All installations)
• 36" [91 cm] backfill • 18" [46 cm] backfill + 6" [15 cm] reinforced concrete • 18" [46 cm] backfill + 8" [20 cm] asphalt

1.3.4.8. The maximum burial depth for standard tanks is 7 feet

1.3.4.9. You must obtain prior written authorization from us to deviate from a standard tank's maximum burial depth.

1.3.4.10. Call your sales representative prior to tank purchase for additional information if the burial depth is to be greater than 7 feet [2.1 meters].

1.3.4.11. If you are in the process of installing a tank and need to consider a deeper burial than the one given for the tank that was ordered, contact eng.support@shawcor.com to discuss available options.

1.3.4.12. If a surface pad is used, surface pads must extend a minimum of 12 inches [30 cm] beyond the tank in all directions.

1.3.4.13. If there is an unattached riser, it must not transmit load from the surface pad to the tank. A minimum space of 6 inches [15 cm] is required between the bottom of the riser and the top of the tank.

1.3.4.14. Traffic loads from the surface pad must not be transmitted to a containment sump or a riser. A minimum space of 3 inches [7.6 cm] is required between the riser or sump and the pad.

1.3.5. TANK SPACING

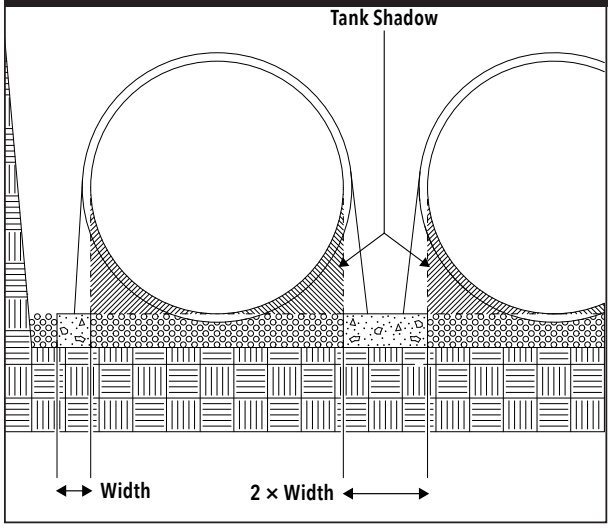
NOTE: In certain excavations with unstable soil, where shoring is permanently in place, the excavation might be classified as a stable-soil excavation. The tank owner should have a qualified engineer certify that the excavation would remain stable for the expected life of the tank installation.

1.3.5.1. GENERAL

1.3.5.1.1. The following are minimum spacings and must be increased as needed to accommodate deadmen or anchor slabs.

1.3.5.1.2. Always provide sufficient clearance to allow the deadmen to be set outside of the tank "shadow." See **Figure 1-3**.

Figure 1-3



1.3.5.1.3. When installing a tank in an excavation that already has an installed tank, contact eng.support@shawcor.com for supplemental instructions.

1.3.5.2. SPACING IN STABLE IN-SITU (NATIVE) SOIL CONDITIONS

1.3.5.2.1. The minimum spacing between the sidewall or endcap of the tank and the side of the excavation must be 18 inches [46 cm]. See **Figure 1-4**.

NOTE: All measurements from the tank sidewalls are to be taken from the outside diameter of the tank ribs.

1.3.5.2.2. If two or more tanks are installed in the same hole, allow for at least 18 inches [46 cm] between the tanks. In Canada, the National Fire Code of Canada requires 24 inches [60 cm] between a fuel tank and another tank or structure. See **Figure 1-4**.

1.3.5.2.3. If two or more tanks are installed in the same hole and deadmen are used, the space between the tanks must be equal to or greater than two times the width of the deadman or deadmen required between the tanks. See **Figure 1-3**.

- The space between tanks using our deadmen is typically 36 inches [91 cm] for 10-foot- and 12-foot-diameter tanks, and 24 inches [60 cm] for tanks smaller than 10 feet in diameter.

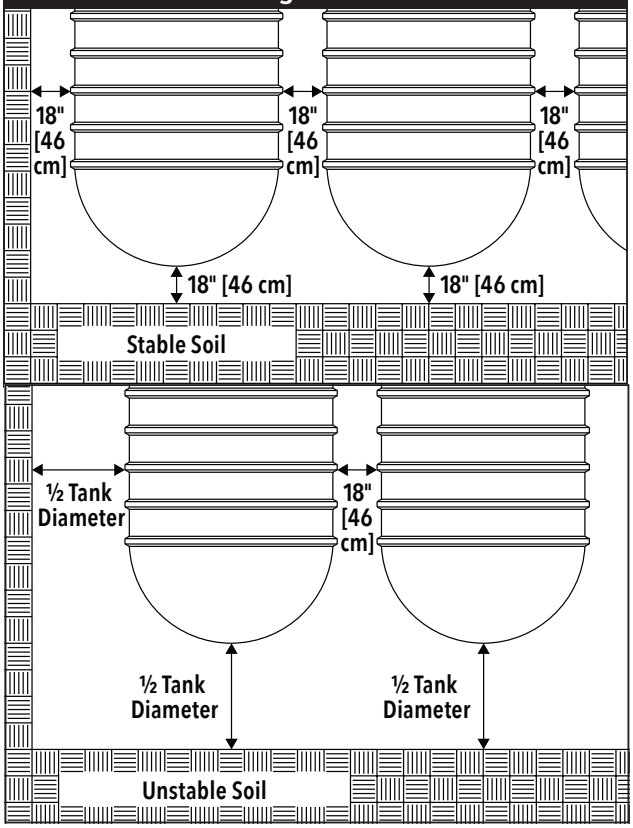
1.3.5.3. SPACING IN UNSTABLE IN-SITU (NATIVE) SOIL CONDITIONS

1.3.5.3.1. We recommend that the tank owner seek the advice of a local foundation professional engineer if the in-situ soil is soft or inherently unstable (for example, peat, quicksand, muck, landfill, soft or highly expansive clay, underground stream, etc.), as further described in **Point 1.3.5.3.2**.

1.3.5.3.2. The excavation must allow a minimum space equal to 1/2 the diameter of the tank between the excavation wall and both the side and the endcap of the tank to enhance lateral resistance (see **Figure 1-4**), if one of the following criteria is met:

- the soil is cohesive soil that is less than 750 lbs./sq. ft. [35.9 kPa] as calculated from an unconfined compression test OR
- the soil has an ultimate bearing capacity of less than 3,500 lbs./sq. ft. [167.6 kPa]

Figure 1-4



1.3.5.3.3. In an excavation where the bottom is unstable, stabilizing materials – such as a reinforced concrete slab – may be required as a foundation over the required 12-inch [30-cm] backfill bedding.

1.3.5.3.4. The spacing between adjacent tanks is to be at least 18 inches [46 cm]. In Canada, the National Fire Code of Canada requires 24 inches [60 cm] between a fuel tank and another tank or structure. See **Figure 1-4**.

1.3.5.3.5. If deadmen are used, follow the spacing requirements between the tanks given in **Point 1.3.5.2.3**.

1.3.6. ANCHORING TANKS

1.3.6.1. GENERAL

1.3.6.1.1. The tank owner or the owner's technical representative is responsible for determining sufficient overburden and/or appropriate anchoring system.

1.3.6.1.2. We recommend that every site be thoroughly evaluated for the potential of a rise in the local water table or of trapped water (a wet-hole condition). Sufficient overburden and/or an appropriate anchoring system must be present to offset buoyancy of the tank in such conditions.

NOTICE

Failure to provide sufficient overburden and/or an appropriate anchoring system could cause tank failure, or could result in damage to the tank and/or surrounding property.

1.3.6.2. ANCHOR STRAPS

GENERAL

1.3.6.2.1. Only our anchor straps may be used when anchoring our tank.

1.3.6.2.2. We have the following anchor strap models:

- D-ring/D-ring anchor straps
- man-out-of-hole (MOH) straps
- hook/hook anchor straps (in Canada only)

NOTE: For information on the hook/hook anchor straps, refer to the Hook/Hook Anchor Straps Instructions supplement. See the Introduction for information on how to obtain this supplement.

1.3.6.2.3. Depending on which type of anchor strap is being used, see **Points 1.3.6.2.6 and 1.3.6.2.7** (D-ring/D-ring) or **Points 1.3.6.2.8, 1.3.6.2.9 and 1.3.6.2.10** (MOH).

1.3.6.2.4. The locations for anchor straps on each tank are marked on the tank ribs by the arrowhead symbols ⧓ (on the tank itself on 4-foot-diameter tanks).

1.3.6.2.5. When straps are placed over ribs, make sure that the area between the straps and the ribs is free of rocks or debris.

D-RING/D-RING ANCHOR STRAPS

1.3.6.2.6. Our D-ring/D-ring anchor straps are designed for anchoring our tanks.

1.3.6.2.7. While in the tank hole, the ends of the D-ring/D-ring anchor straps are connected to anchor points using hardware described in **Section 1.3.6.3**.

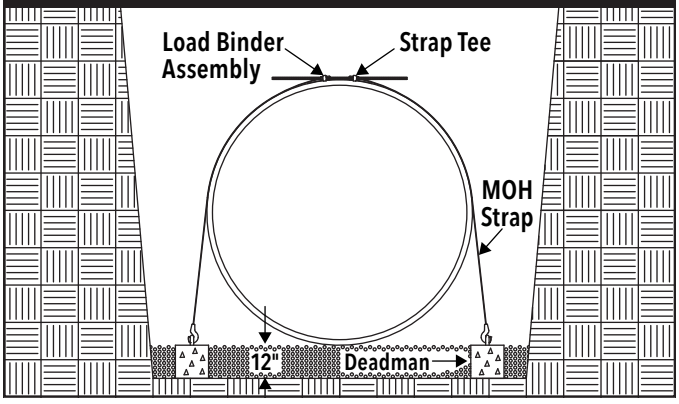
MAN-OUT-OF-HOLE (MOH) STRAPS

1.3.6.2.8. The man-out-of-hole (MOH) strap system is designed for use in installations where water is in the excavation and/or where personnel may not enter the tank hole.

1.3.6.2.9. The MOH strap consists of two identical halves.

1.3.6.2.10. The ends of the MOH anchor strap are connected directly to anchor points, and the two strap halves are connected to each other at the top of the tank. See **Figure 1-5**.

Figure 1-5



1.3.6.2.11. MOH anchor straps are to be installed in the following way:

- Lift the strap with the hook end down and the hook facing away from the tank.
- Lower the hook end of the strap between the tank and the anchor point, and hook the strap to the anchor point.
- Put a washer and a blind nut (acorn nut) on one end of the threaded rod.
- Feed the rod through the hole in the strap-end connector.
- Put a washer and a nut on the other end of the threaded rod.
- Center the wear plate on the top center line of the marked ribs.
- Lower the threaded rod, washer and nut into the channel section on the strap-end connector, taking care to place the washer and nut on the outside of the connector.
- Hand-tighten the nuts.

1.3.6.2.12. Repeat the bulleted items in **Point 1.3.6.2.11** for the second rod of the assembly.

1.3.6.2.13. After the two threaded rods are placed, tighten the threaded rods, using a torque wrench to tighten to 25-30 foot-pounds, or until snug.

1.3.6.2.14. Repeat the bulleted items in **Point 1.3.6.2.11** for each of the load binder assemblies.

1.3.6.3. HARDWARE AND ANCHOR POINTS

1.3.6.3.1. When our anchoring hardware is not being used, the installing contractor is responsible for providing hardware and anchor points of strength for the tank being installed.

1.3.6.3.2. The particular configuration of hardware will be determined by the contractor, the owner or the owner's representative, but is to adhere to the following:

- Anchoring hardware must be manufactured to industry standards and dimensions, and sized according to **Table 1-3.**
- All exposed metal on the anchoring system must be coated or galvanized to protect against corrosion.
- If the hardware used is not provided by us, contact the hardware manufacturer or supplier for specific information on hardware and its use.

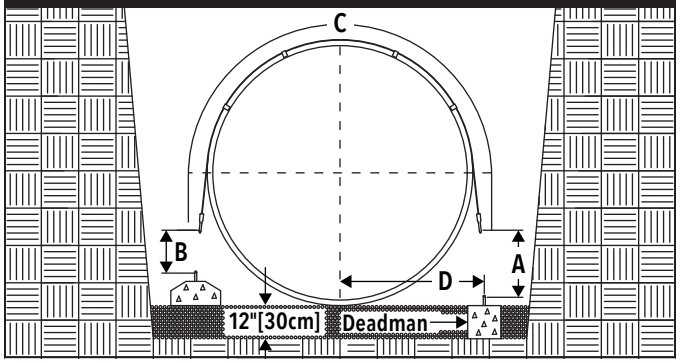
1.3.6.3.3. When D-ring/D-ring straps are shipped and turnbuckles are ordered from us, we may ship extra hardware that may or may not be necessary with alternate deadmen placement.

1.3.6.3.4. Locate the anchor points as shown in **Figure 1-6.** Refer to dimensions in **Table 1-4**. Align (within a tolerance of ±1 inch) all anchor points.

Table 1-3

Tank Diameter	Minimum Turnbuckle Diameter (by Type)			Minimum Wire Rope Diameter
	Hook	Jaw	Eye	
4-foot	¾"	½"	½"	⅜"
6-foot	¾"	½"	½"	⅜"
8-foot	1¼"	¾"	¾"	½"
10-foot	1¼"	¾"	¾"	½"
12-foot	1¼"	¾"	¾"	½"

Figure 1-6



NOTE: If a D-ring/D-ring strap is used on a 4-foot-diameter tank, the anchor point must be 3 inches [8 cm] below the top of the bedding.

1.3.6.3.5. Use only appropriately sized hardware with the strap eye. See **Figure 1-7** for dimensions of strap eye.

Figure 1-7

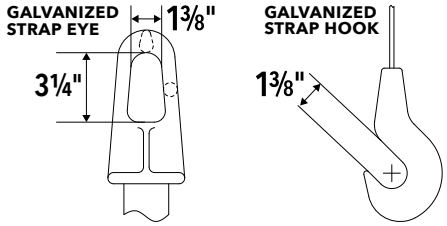
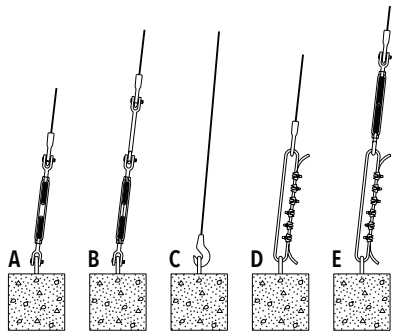


Table 1-4

Nominal Tank Diameter	A: Strap Eye To Anchor Point	B: Alternate Dimension	C: Strap Length	D: Center of Tank to Center of Deadmen
4-foot	10" [25 cm]	not reccommended	100" [254 cm]	31" [79 cm]
6-foot	23" [58 cm]	not reccommended	145" [368 cm]	43" [109 cm]
8-foot (mfd. in US)	29" [74 cm]	17" [43 cm]	181" [460 cm]	53" [135 cm]
8-foot (mfd. in CAN)	30" [76 cm]	18" [46 cm]	195" [495 cm]	57" [145 cm]
10-foot (mfd. in US)	38" [97 cm]	26" [66 cm]	236" [599 cm]	70" [178 cm]
10-foot (mfd. in CAN)	39" [99 cm]	27" [69 cm]	236" [599 cm]	71" [180 cm]
12-foot	46" [117 cm]	34" [86 cm]	271" [688 cm]	79" [201 cm]

1.3.6.3.6. When connecting the end of an anchor strap to the anchor point, common methods are those shown in **Figure 1-8**: **A**) using a drop-forged turnbuckle, **B**) using a turnbuckle and turnbuckle extension, **C**) using the hook end of the strap, **D**) using a looped wire rope, **E**) using a combination of a drop-forged turnbuckle and a looped wire rope.

Figure 1-8



1.3.6.3.7. If using a wire rope, refer to recommendations of wire rope manufacturer and supplier, and follow accepted industry standards when selecting, using, attaching or connecting wire rope. Most wire rope suppliers provide rigging educational courses, including free online options. **See Figure 1-8** and **Figure 1-9**.

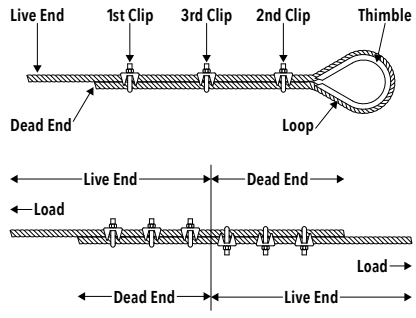
1.3.6.3.8. See **Table 1-3** for minimum wire-rope diameter for each tank diameter.

1.3.6.3.9. The installer is responsible for using appropriate and approved engineering practices when fastening wire rope.

1.3.6.3.10. When fastening wire rope see **Figure 1-9**:

- Use a minimum of 2 clips for a 3/8-inch [1-cm] wire rope and 3 clips for a ½-inch [1.3-cm] wire rope on each termination.
- If forming a loop in the wire rope, a splice is required for connecting the two ends together.
- Standard rigging practice for splicing wire rope calls for using twice the number of clips recommended for a single-end termination.
- Use a minimum of 4 clips for a 3/8-inch [1-cm] wire rope and a minimum of 6 clips for a ½-inch [1.3-cm] wire rope.

Figure 1-9



1.3.6.4. DEADMEN

1.3.6.4.1. Deadmen help anchor tanks in installations in which there is potential for a high water table or trapped water.

1.3.6.4.2. A deadman is typically a reinforced concrete beam and should be designed according to the applicable American Concrete Institute code or the applicable Canadian Standards Association (CSA) standard, whichever is relevant.

1.3.6.4.3. We recommend that you use one of our strap systems with our factory-supplied deadmen.

1.3.6.4.4. When installing any size tank, and when using our D-ring/D-ring anchor straps and prefabricated deadmen, the deadmen are to be placed so that their tops are even with the bottom of the tank. See **Figure 1-6** and **Table 1-4** for anchor-point dimensions when using our deadmen.

- For 8-foot-, 10-foot- and 12-foot-diameter tanks, an option when using D-ring/D-ring straps is to place the deadmen on the bedding so the bottoms of the deadmen are even with the bottom of the tank.
- This is not recommended for 4-foot- and 6-foot-diameter tanks.

1.3.6.4.5. The width and thickness of a deadman depends on the following:

- tank diameter
- water-table elevation
- number of containment sumps
- burial depth

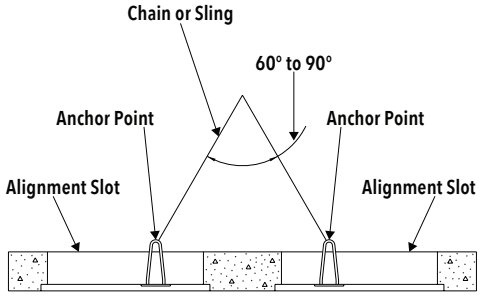
1.3.6.4.6. The total length of a deadman (on each side of the tank) is typically equal to the length of the tank.

- Our prefabricated deadmen come in various lengths.
- Deadmen are to be butted together end to end on each side of the tank when multiple sections are used.
- Depending on the installation, multiple deadmen may be required and are to adhere to the following:
  - ▸ The total length of the assembled deadmen must be appropriate for the installed tank.
  - ▸ Each section of assembled deadmen must contain at least 2 balanced anchor points
  - ▸ An equal number of deadmen is required on both sides of the tank.
- Our prefabricated deadmen are supplied with ¾-inch-diameter galvanized adjustable anchor points (subsequently referred to as anchor points). See **Figure 1-10**.
  - ▸ These anchor points protrude up through the slots in the deadmen and are temporarily supported with cotter pins.

⚠WARNING

Only use the anchor points when lifting and positioning the deadmen. A spreader bar may be required to lift longer sections of deadmen. Use guide ropes to guide the deadmen when lifting. Failure to do so could result in death or serious injury.

Figure 1-10



1.3.6.4.7. See **Table 1-5** for typical cast-in-place deadmen dimensions for tanks (other than 10-foot-diameter tanks with a capacity greater than 25,000 gallons [95,000 liters]), given the following scenario:

- an empty tank
- a 3-foot [91-cm] burial depth
- groundwater to grade
- 1 containment sump

Table 1-5

Tank Diameter	Typical Cast-in-Place Deadmen Dimensions (Width x Depth)
4-foot	6" [15 cm] × 6" [15 cm]
6-foot	12" [30 cm] × 12" [30 cm]
8-foot	12" [30 cm] × 12" [30 cm]
10-foot	18" [46 cm] × 9" [23 cm]
12-foot	36" [91 cm] × 8" [20 cm]

1.3.6.4.8. Tanks with more than 1 containment sump and 10-foot-diameter tanks with a capacity greater than 25,000 gallons [95,000 liters] may require either a deeper burial or deadmen larger than those shown in **Table 1-5**. Contact eng.support@shawcor.com for further information.

1.3.6.4.9. The minimum spacing between tanks must be increased to accommodate deadmen.

1.3.6.4.10. Always provide sufficient clearance to allow the deadmen to be set outside the tank "shadow." See **Section 1.3.5** for tank spacing information.

1.3.6.4.11. For placement of prefabricated deadmen, see **Figure 1-3**.

1.3.6.4.12. Some contractors use the deadmen as a construction guide for proper depth of bedding, if deadmen are installed in the standard position.

NOTE: Low-profile deadmen are not 12 inches [30 cm] high.

1.3.6.5. TURNBUCKLES

1.3.6.5.1. We also offer a turnbuckle that will connect the deadman anchor point to the FRP anchor strap. See **Figure 1-8**. When the deadman is properly positioned, this will eliminate the use of wire rope. See **Section 1.3.6.2** for more detail on anchor straps.

1.3.6.6. ANCHOR SLABS

NOTE: The tank owner is responsible for the design of anchor slabs.

1.3.6.6.1. An anchor slab is a reinforced concrete base and should be designed according to the applicable American Concrete Institute code or the applicable Canadian Standards Association (CSA) standard, whichever is relevant.

1.3.6.6.2. The total length of the slab must be at least the same as the length of the tank.

1.3.6.6.3. The minimum slab thickness is 8 inches [20 cm].

1.3.6.6.4. The width of the slab depends on the tank diameter. The slab must extend a minimum of 18 inches [46 cm] (12 inches [30 cm] for 4-foot-diameter tanks) beyond each side of the tank.

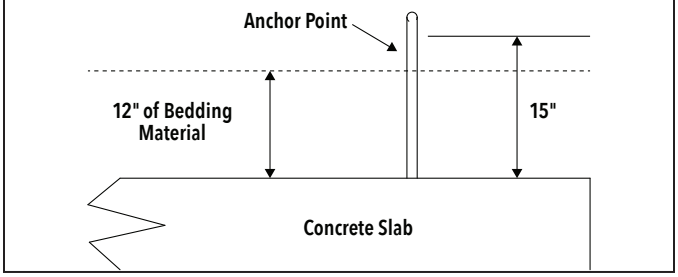
1.3.6.6.5. Provide a separate anchor point for each anchor strap.

1.3.6.6.6. All anchor points must be engineered to withstand the tank's buoyancy forces.

1.3.6.6.7. Refer to **Figure 1-11** for anchor-point height. Refer to **Table 1-4** for other anchor-point dimensions.

1.3.6.6.8. When using a concrete anchor slab, allow sufficient depth in the excavation for 12 inches [30 cm] of bedding material between the tank and the anchor slab. See **Figure 1-11**.

Figure 1-11



1.3.6.6.9. When using our straps and turnbuckles, anchor points must extend at least 3 inches [8 cm] above the bedding. With a 12-inch [30-cm] bedding, the anchor point is 15 inches [38 cm] above the slab.

1.3.6.7. TAKING DIAMETER MEASUREMENTS

NOTE: All tank deflection limits given in these instructions relate to allowable limits using common measurement methods described in this section.

1.3.6.7.1. Take tank-diameter measurements at various stages of the installation to verify that tank deflection is within allowable limit. Deflection in excess of the allowable deflection indicates improper installation. Contact eng.support@shawcor.com for information when taking corrective action is needed.

1.3.6.7.2. Take diameter measurements at one or more locations on each tank or tank compartment. Take the measurement at the centermost location possible of the tank or compartment.

1.3.6.7.3. To calculate the deflection at any time, take a diameter measurement and subtract it from Measurement #1. Compare this deflection to the applicable allowable deflection in **Table 1-6**.

Table 1-6

Tank Diameter	Allowable Deflection
4-foot	½" [1.3 cm]
6-foot	¾" [1.9 cm]
8-foot	1⅛" [2.9 cm]
10-foot	1½" [3.8 cm]
12-foot	1¾" [4.5 cm]

REQUIRED MEASUREMENTS

1.3.6.7.4. There are four times when you are required to check deflection by taking diameter measurements:

- before installation begins
- after applying anchor straps (if used)
- after backfilling is brought to the top of the tank
- after backfilling is brought to subgrade

1.3.6.7.5. The first measurement is a comparison reference for subsequent measurements to check proper backfill placement.

METHODS

1.3.6.7.6. Frequently, measurements are taken using a tape measure or a dipstick (with or without a standpipe).

1.3.6.7.7. If using a wooden dipstick, drive a nonsparking, small-headed nail halfway into the dipstick 1 inch [3 cm] above its base.

WITHOUT A STANDPIPE

1.3.6.7.8. Place the dipstick into a service fitting. Measure the distance from the tank bottom to the top of the fitting. Record this measurement.

1.3.6.7.9. Pull the dipstick up until the exposed nail catches on the inside of the tank top. Measure the distance from the inside of the tank top to the top of the fitting. Subtract the distance from the nail to the base of the dipstick. Record this measurement.

1.3.6.7.10. Subtract the second measurement from the first measurement to calculate the deflection. Record the deflection on the Tank Installation Checklist at the appropriate place: Measurement #1,2,3 or 4.

WITH A STANDPIPE

1.3.6.7.11. Place the dipstick into a service fitting with a standpipe. Measure the distance from the tank bottom to the top of the standpipe. Record this measurement.

1.3.6.7.12. Pull the dipstick up until the nail catches on the inside top of the tank. Measure the distance from the inside of the tank top to the top of the standpipe. Subtract the distance from the nail to the base of the dipstick. Record this measurement.

1.3.6.7.13. Subtract the second measurement from the first measurement to calculate the deflection. Record the deflection on the Tank Installation Checklist at the appropriate place: Measurement #1,2,3 or 4.

1.3.6.8. ONSITE PRESSURE-TESTING REQUIREMENTS

1.3.6.8.1. At various stages of the installation process, there may be onsite testing requirements.

1.3.6.8.2. To pressure test tanks, you need to construct a test manifold. See **Figure 4-1**.

- The pressure-supply gauge must have a maximum full-scale reading of 15 psig [100 kPa].
- The pressure-relief device must be rated to a maximum of 6 psig [40 kPa], or 4 psig [28 kPa] for a 12-foot-diameter tank, to reduce the risk of overpressurizing the tank.

NOTE: For multicompartment tanks, you need a test manifold for each compartment.

2: HANDLING AND STORING TANKS

2.1. UNLOADING, HOISTING AND GUIDING TANKS

2.1.1. Although our tanks are rugged, the tank owner and/or tank owner's representative must take care so that the tank is not dropped or damaged during loading, unloading, handling and storage at the jobsite.

2.1.2. Move tanks by lifting and setting only. Always lift tanks by using the lifting lugs provided with the tank. Distribute the lifting load evenly between the lifting lugs. Follow standard rigging practices, including the use of spreader bars to level the tank as it is lifted. See **Lifting Lug Sidebar.**

NOTICE

Never roll, drag or drop the tank. This could result in damage to the tank.

NOTE: Larger tanks may be provided with guide lugs for attachment of guide ropes during lifting and positioning operations. Do not use guide lugs for lifting.

2.1.3. Before the tank is unloaded or relocated on the jobsite (and before preinstallation testing at the jobsite), tank owner and/or tank owner's representative must:

- Visually inspect the entire exterior surface of the tank to make sure that no shipping or handling damage has occurred. Look particularly for visible damage, cracks or deep scrapes.
- Sign the shipping papers accepting the tank as delivered. Any damage observed must be noted in these papers.
- Be sure that all equipment used to lift the tank is rated to handle the load. See **Tank Data Charts** in this *Installation Manual* for weights.
- Select a smooth, solid, level area on which to place the tank, and clear that area of all large rocks, trash and debris.
- Make sure that all tools and other items that may damage the tank during unloading are removed from the trailer bed.

2.1.4. When unloading the tank from the truck, tank owner and/or tank owner's representative must make sure that the tank is secured in such a way that it does not roll off the truck.

⚠WARNING

Do not release straps securing the tank to the truck until lifting equipment (such as a crane) is secured to the tank's lifting lug(s) and until anyone in a position to be injured by the tank's movement is in a safe location. Failure to do so could result in death, serious injury or property damage.

⚠WARNING

Always secure the tank before moving, rotating or lifting it. This is commonly done by connecting a crane or backhoe to the lifting lugs. Failure to follow this warning could result in death or serious injury.

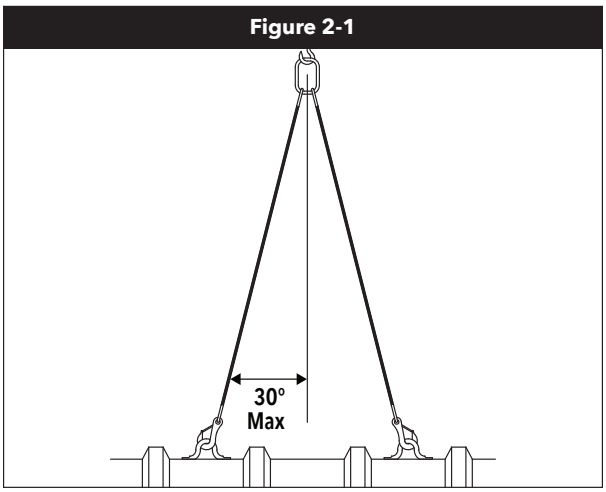
⚠WARNING

While moving or lifting the tank, do not position any part of your body underneath the tank. Failure to follow this warning could result in death or serious injury.

2.1.5. When hoisting and guiding the tank:

- Choose suitable lifting sling(s) for the tank being installed.
- When using multiple lifting lugs, the angle of the lifting sling should never exceed 30 degrees from vertical. See **Figure 2-1.**

Figure 2-1

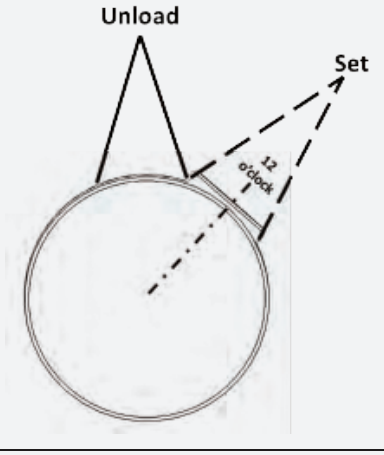
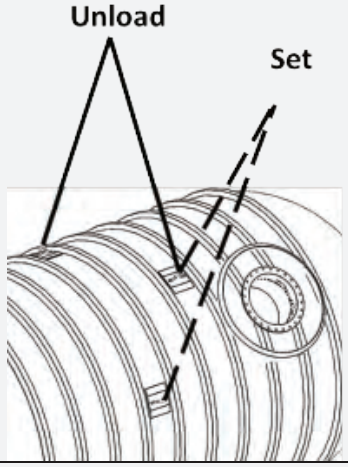
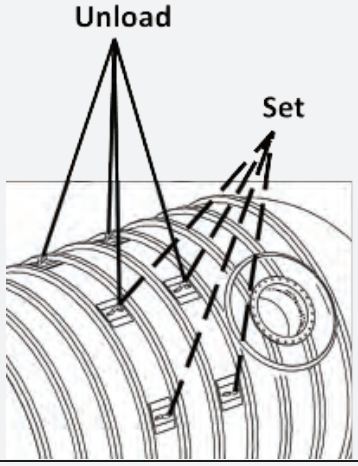


LIFTING-LUG SIDEBAR

Read Before Hoisting Tanks

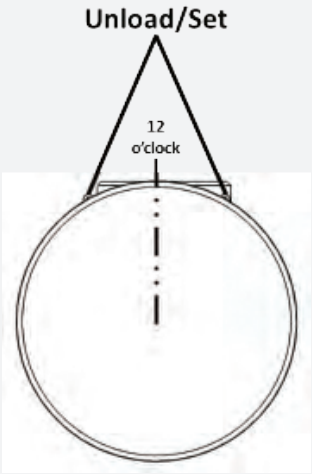
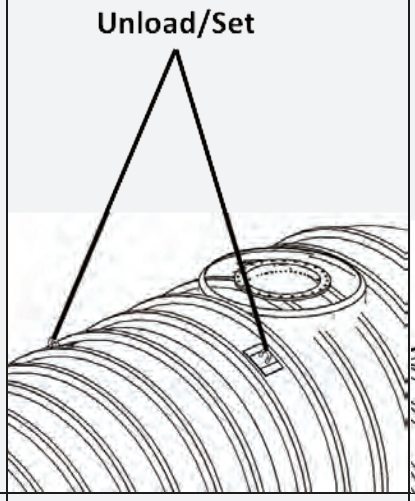
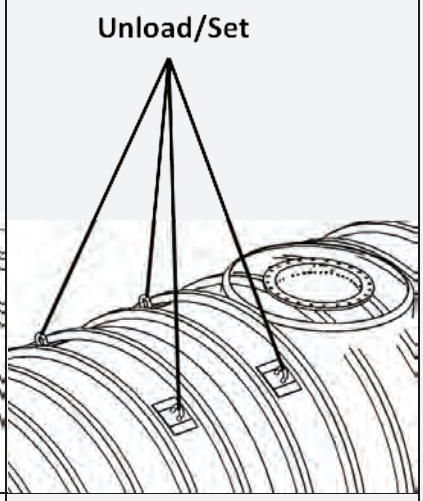
Tanks in the Rotated Position

These tanks have either 3 or 6 total lifting lugs

		
End view of a tank in the **rotated position**	Always hoist a tank with 2 lifting lugs if there are 3 total lifting lugs	Always hoist a tank with 4 lifting lugs if there are 6 total lifting lugs

Tanks in the Upright Position

These tanks have either 2 or 4 total lifting lugs

		
End view of a tank in the **upright position**	Always hoist a tank with 2 lifting lugs if there are 2 total lifting lugs when the tank is upright	Always hoist a tank with 4 lifting lugs if there are 4 total lifting lugs when the tank is upright

XERXES® BY SHAWCOR

- Do not wrap chain or cable around the tank at any time, including when securing the tank on the ground.
- Use guide ropes to guide the tank when needed.

⚠WARNING

Do not use guide lugs for lifting. Failure to follow this warning could result in death, serious injury or property damage.

2.16. When handling a tank with a bottom sump or fitting, always take extra care so that the bottom sump or fitting is not damaged by contact with any other object, such as the truck bed or the ground.

2.2. STORING TANKS

2.2.1. Whenever a tank is temporarily placed above the ground at the site, place it on a smooth, solid, level area that is clear of large rocks, trash and debris, and then chock it in place to prevent rolling.

⚠WARNING

Always chock the tank. The tank is heavy and has a large surface area. The tank will roll on sloped surfaces and could be blown about by the wind. Movement of the tank could result in death or serious injury.

2.2.2. Tie the tank down if high winds are expected. Do not use wire rope or chains. Doing so could damage the tank.

2.2.3. Never place tie-down straps over collars, reservoirs or access openings.

2.2.4. Whenever a tank is temporarily placed above the ground at the site, always take extra care so water does not enter the collar. We recommend that the tank be rotated and/or the collar covered.

2.2.5. Ensure that the tank is UV-protected if it will be stored above the ground for an extended period of time, typically 12 months depending on the geographic location of the installation.

NOTICE

If water enters the collar, it could freeze and could result in damage to the tank and/or collar.

3: PREINSTALLATION INSPECTION AND TESTING

NOTE: These instructions pertain to single-wall and double-wall tanks. For information on triple-wall preinstallation testing, contact eng.support@shawcor.com.

3.1. GENERAL

⚠WARNING

Do not conduct preinstallation testing while the tank is on a trailer. Failure to follow this warning could result in death or serious injury.

NOTICE

Do not put product in the tank until all necessary preinstallation inspection and testing is completed. Failure to follow this notice could result in property damage

3.1.1. The applicable inspection and testing procedures in **Sections 3** and **4** must be performed to validate the applicable limited warranty.

3.1.2. All tanks are tested and inspected at the factory prior to shipment. However, in order to verify the absence of any damage resulting from shipping or handling, prior to installation all tanks must also be inspected at the site. Some tanks must also be tested at the site prior to installation according to the applicable procedures.

⚠WARNING

Do not lift or hoist a tank under pressure. Failure to follow this warning could result in death or serious injury.

3.1.3. Not all tanks are pressure testable in the field. We recommend the pressure test on any tank that can be safely sealed for testing. See **Section 4** for pressure-test instructions. If a tank needs to be hydrostatically tested, see **Section 4** and follow those instructions.

3.1.4. If the tank is a water/wastewater tank equipped for optional preinstallation testing, after inspecting the tank (see **Section 3.2**), follow procedures in the Preinstallation Testing Instructions for Water/Wastewater Tanks Factory-Equipped for Pressure Testing. See the **Introduction** for information on how to obtain this supplement.

3.1.5. If damage of any kind is detected, contact eng.support@shawcor.com.

NOTE: Do not attempt unauthorized repairs.

3.2. INSPECTING THE TANK

3.2.1. Thoroughly inspect the entire outside surface of the tank for signs of shipping or handling damage. Rotate or lift the tank to inspect the bottom of the tank.

3.2.2. If damage of any kind is detected, contact eng.support@shawcor.com.

NOTE: Do not attempt unauthorized repairs.

4: TESTING DURING INSTALLATION

4.1. TANK TYPES

4.1.1. Typically, all underground storage tanks need to be tested in the field to confirm that there are no problems with the tank. We recommend the pressure test on any tank that can be safely sealed for testing. Tanks that cannot be sealed, including those with large access openings or with pipe nozzles, may be tested hydrostatically if required.

4.1.2. We recommend that the following tanks we manufacture are pressure tested during installation:

- fuel tanks
- DEF tanks
- chemical tanks
- potable water tanks
- oil/water separators
- pipeline sump tanks

4.1.3. All UL-label, ULC-label and potable water tanks must be pressure tested after backfill is brought close to the top of the tank.

4.1.4. Tanks that cannot be sealed and are not equipped for pressure testing may require hydrostatic testing. They include the following:

- water tanks
- wastewater tanks

4.2. PRESSURE-TEST PRETESTING PROCEDURES

NOTICE

Do not install any piping or fittings other than test fittings until all preinstallation testing has been completed. Failure to follow this notice could result in property damage.

NOTICE

Never pressurize a wet interstitial space. Doing so could result in damage to the primary tank and/or tank failure.

4.2.1. Someone must be with the tank at all times during pressure testing.

4.2.2. Prior to the pressure test, remove all plugs, apply sealant, and replace and tighten plugs.

⚠WARNING

Before beginning the pressure test, notify all people on the test site to remain in a safe location. Never leave a tank under pressure unattended. Stand clear of manways, fittings and tank ends during the test. When the tank is under pressure, the manways, access openings and/or fittings may dislodge, or the tank could rupture, and this could result in death or serious injury.

4.2.3. If the tank being installed is not a pressure-testable tank, proceed to **Section 5**.

4.3. PREPARING THE TANK FOR PRESSURE TESTING

4.3.1. The pressure-test pressure for 4-foot-diameter through 10-foot-diameter tanks is 5 psig [35 kPa], and 3 psig [21 kPa] for 12-foot-diameter tanks.

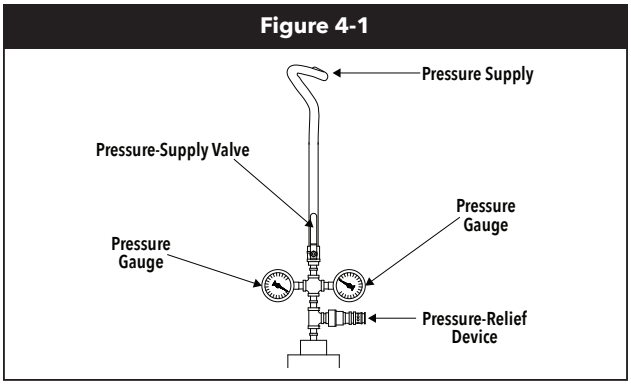
⚠WARNING

Do not overpressurize the tank. Position the pressure gauges so that the pressure readings can be clearly read at all times. The pressure gauge must have a pressure-relief valve that is used and set at 6 psig [40 kPa] (4 psig [28 kPa] for 12-foot-diameter tanks). Failure to follow this warning could result in death or serious injury.

4.3.2. The tester is responsible for verifying that all of the test equipment is in good working condition, and is properly configured and calibrated.

4.3.3. Construct a test manifold with two pressure gauges as shown in **Figure 4-1**. Each pressure gauge must have a maximum full-scale reading of 15 psig [100 kPa] with graduations in ½ psig [2.5 kPa] increments, and a pressure-relief valve set at 6 psig [40 kPa] (4 psig for 12-foot-diameter tanks).

Figure 4-1



4.3.4. Take particular care to note the following:

- An interstitial test manifold is needed for testing the dry interstitial space of a pressure-testable double-wall tank.
- A test manifold is not required for testing a tank interstice filled with monitoring fluid.
- All compartments of a multicompartment tank may be tested simultaneously, or each compartment may be tested separately.
- When pressure testing multicompartment tanks, a test manifold is needed for each compartment.

4.3.5. During pressure tests, ambient air temperature can affect pressure-gauge readings.

4.3.6. When testing tanks with wet monitoring, remove the reservoir fitting plug.

4.3.7. If the tank has threaded fittings, the installer is responsible for selecting a thread sealant that is compatible with the product being stored. Some sealants cannot be used with some stored products.

4.3.8. Remove factory-supplied temporary plugs and install permanent plugs in all openings where piping will not be installed.

4.3.9. Make sure all manway bolts or flange bolts are torqued to 25 ft-lb [34 N-m], and fitting plugs are properly doped and sealed.

4.3.10. The tank may be pressure tested with the factory-supplied temporary plugs. Redope and tighten temporary plugs if needed.

4.3.11. Keep one service fitting open in each compartment for the test manifold.

4.3.12. Tanks equipped with flanged nozzles may require contractor-supplied blind flanges for preinstallation pressure testing.

4.4. PRESSURIZING THE PRIMARY TANK

4.4.1. Install the test manifold in the open service fitting and connect the pressure source to the test manifold.

4.4.2. If the interstitial space is dry, close the valve on the interstitial test manifold before pressurizing the primary tank.

4.4.3. Open the pressure-supply valve and pressurize the primary tank to 5 psig [35 kPa] (3 psig [21 kPa] for 12-foot-diameter tanks). Allow a few minutes for the temperature in the tank to stabilize, then allow the pressure to stabilize by adding or removing pressure as necessary.

4.4.4. Close the valve on the primary tank test manifold and disconnect the pressure supply.

4.4.5. Hold and monitor the pressure for a minimum of 1 hour.

4.4.6. If the interstitial test manifold shows a pressure build-up in the interstitial space of a dry-monitor, double-wall tank, contact eng.support@shawcor.com.

NOTE: Do not attempt unauthorized repairs.

4.5. PRESSURIZING THE INTERSTITIAL SPACE IN A DRY TANK

⚠WARNING

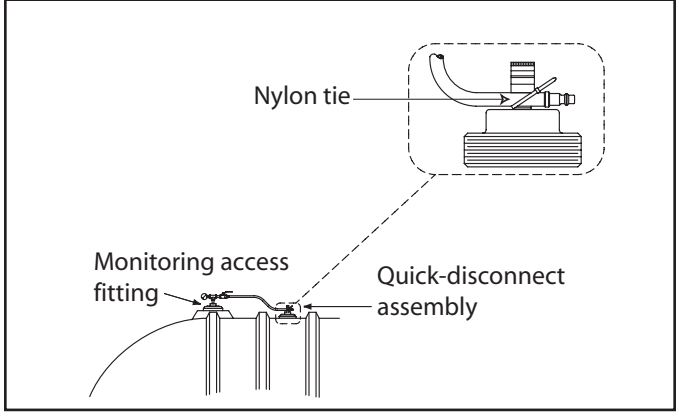
Never lift or hoist a tank under pressure. Failure to follow this warning could result in death or serious injury.

NOTE: Do not attempt unauthorized repairs.

4.5.1. Tanks with a dry interstitial space come with a quick-disconnect assembly that may be used as the interstitial test manifold. See **Figure 4-2**.

4.5.2. If the tank is not configured as shown in **Figure 4-2** prior to installation, contact eng.support@shawcor.com.

Figure 4-2



4.5.3. The quick-disconnect assembly must not be connected to the service fitting when pressure testing the primary tank. Keep the nylon tie in place.

4.5.4. Maintain the pressure in the primary tank.

NOTICE

Do not connect the pressure supply directly to the access fitting for interstitial-space monitoring. Pressurizing the secondary tank (interstitial space) by itself could damage the primary tank or cause tank failure.

4.5.5. Free the hose from the service fitting by cutting the nylon tie.

4.5.6. Insert the hose into the quick-disconnect fitting and open the valve to allow pressure to transfer from the primary tank to the interstitial space.

4.5.7. Reconnect the pressure-supply line. Allow the pressure to stabilize at 5 psig [35 kPa] (3 psig [21 kPa] for 12-foot-diameter tanks) by adding or removing pressure as necessary.

4.5.8. Close the pressure-supply valve on the test manifold and disconnect the pressure-supply line.

4.6. SOAPING THE TANK

4.6.1. After pressurizing the tank, soap the tank to check the tank's integrity.

- Soap either the fittings, manways and covers or the entire exterior of the tank, depending on what part of the testing process the tester is at and what kind of tank is being pressure tested. See **Pressure-Testing Sidebar** instructions for specific types of tanks.
- Watch for active bubbles. There should not be any.
- During freezing conditions, a suitable solution such as windshield washer fluid may be added to the soap and water mixture.

4.6.2. When doing a soap test, rotate the tank to check the bottom. Do not rotate a tank filled with monitoring fluid.

NOTE: Before rotating the tank, place protective material on the area on which the tank will be rotated. Make sure the area is flat and free of large or sharp objects, such as rocks, which may damage the tank.

4.6.3. Rotate the tank slowly and carefully to avoid developing too much momentum. Momentum can grow because manways and fittings on top of the tank make it top heavy.

NOTE: Make sure the tank's fittings and manways never touch the ground. Do not rotate the tank more than 120 degrees from the initial starting point.

4.6.4. If damage is detected, contact eng.support@shawcor.com.

NOTE: Do not attempt unauthorized repairs.

4.7. PERFORMING VISUAL CHECKS ON A TANK WITH A WET INTERSTITIAL SPACE

NOTICE

Never pressurize a wet interstitial space. Doing so could result in damage to the tank and/or tank failure.

NOTICE

Never rotate a tank filled with monitoring fluid. Doing so could result in damage to the tank and/or tank failure.

4.7.1. Check that the tank has monitoring fluid in the reservoir. Measure the level of the monitoring fluid in the reservoir and record on checklist.

NOTE: If the reservoir is less than 1/3 full, contact eng.support@shawcor.com. See the back cover of the *Installation Manual* for contact numbers.

4.7.2. Visually check both the interior and the exterior of the tank for monitoring fluid. (The monitoring fluid is dyed blue to distinguish between moisture and monitoring fluid.) There should not be any.

- Visually check the interior of the tank.
  - ▸ Check each compartment of a multicompartment tank.
- Visually check the exterior of the tank.
  - ▸ Check the exterior of each compartment of a multicompartment tank.
  - ▸ If monitoring fluid is found, wipe the tank dry and verify that the monitoring fluid does not reappear.
  - ▸ Lift the tank to check the bottom – do not roll the tank.

NOTE: Tanks are shipped with a pop-off valve to ensure that excess pressure does not build in the interstitial space during shipping and/or storage. Conditions such as excess heat can cause this valve to release. If the tank is rotated and the ambient temperature is much higher than when it was shipped, the pop-off valve will relieve the pressure, which may result in monitoring fluid on the tank surface. If this occurs, wipe the tank dry and verify that the monitoring fluid does not reappear.

NOTE: If there is still monitoring fluid present on the tank after completing this process, contact eng.support@shawcor.com.

4.8. RELEASING PRESSURE FROM THE TANK

4.8.1. If there is an interstitial space to pressurize, open the valve of the interstitial test manifold and carefully release the pressure in the interstitial space first.

4.8.2. If the tank is a multicompartment tank, carefully release the pressure in the end compartments first.

4.8.3. Then carefully release the pressure from the base tank.

NOTICE

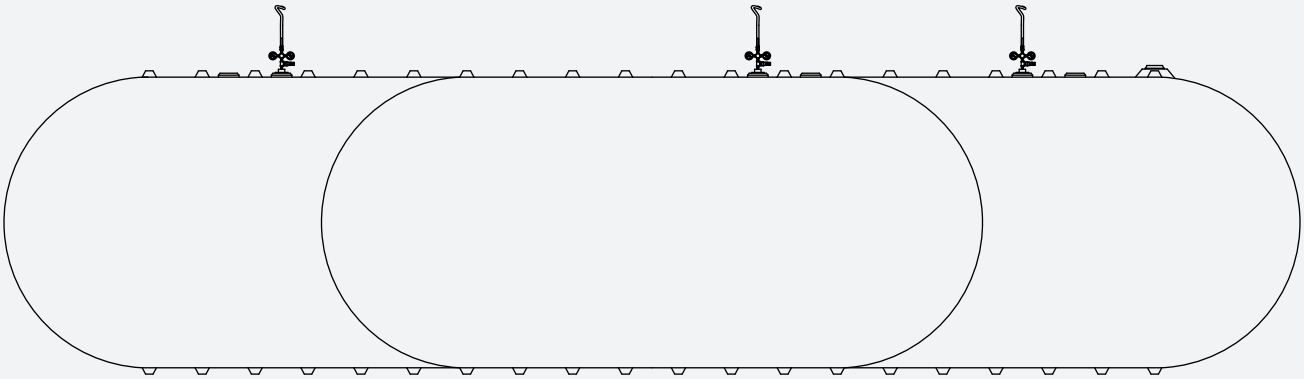
Never allow the pressure in the interstitial space to be greater than the pressure in a primary tank. Failure to follow this notice could result in damage to a primary tank and/or tank failure.

⚠WARNING

Never remove the service-fitting plugs when there is pressure in the tank. Failure to follow this warning could result in death or serious injury.

4.8.4. Remove the test manifolds and replace the protective covers in the service fittings.

PRESSURE-TESTING SIDEBAR



Single-Wall (or Primary) Tank

1. Pressurize the tank.
2. Check threaded or flanged joints for problems with the tank.
3. Soap the entire exterior of the tank (not applicable for a double-wall tank), including all service fittings and manways when present.
4. Hold and monitor the pressure for a minimum of 1 hour.
5. Carefully release the pressure from the tank.
6. Remove the test manifold and replace the protective covers in the service fittings.

Wet Double-Wall Tank

NOTICE

Never pressurize a wet interstitial space. Doing so could result in damage to the primary tank and/or tank failure.

1. Check the level of the monitoring fluid in the reservoir.
2. Visually check the interior and the exterior of each compartment for the presence of monitoring fluid.
3. If the monitoring fluid is not at the proper level, and/or monitoring fluid is found on either the interior or the exterior of any compartment, contact eng.support@shawcor.com.
4. If there is no monitoring fluid on either the interior or the exterior of any compartment, backfill the tank to the top of the tank.
5. After the tank is backfilled to the top of the tank, it may be pressure tested as in Single-Wall (or Primary) Tank steps 1-6.

NOTE: For multicompartment tanks, follow these instructions to test each compartment.

Dry Double-Wall Tank Not Under Vacuum

1. Test the primary tank as in Single-Wall (or Primary) Tank steps 1-4.
2. Use the quick-disconnect assembly to pressurize the interstitial space.
3. Soap the entire exterior of the tank.
4. Hold and monitor the pressure in the interstitial space for a minimum of 1 hour.
5. Carefully release the pressure from the primary tank.
6. Remove the test manifold and replace the protective covers in the service fittings.
7. After the tank is backfilled to the top of the tank, it may be pressure tested as in Single-Wall (or Primary) Tank steps 1-6.

Dry Double-Wall Multicompartment Tank Not Under Vacuum

1. Install a test manifold in the base tank and in each end compartment.
2. Pressurize the base tank and the end compartment(s) as in a Single-Wall (or Primary) Tank steps 1-4.
3. Pressurize the interstitial space using the quick-disconnect assembly and follow instructions for Dry Double-Wall Tank Not Under Vacuum steps 3-6.
4. After the tank is backfilled to the top of the tank, it may be pressure tested as in Single-Wall (or Primary) Tank steps 1-6.

Dry Double-Wall Tank Under Vacuum

1. Follow the pass/fail criteria shown in **Section 4.9.4** for double-wall tank shipped under vacuum to determine if preinstallation pressure testing is required.
2. After the tank is backfilled to the top of the tank, it may be pressure tested as in Single-Wall (or Primary) Tank steps 1-6.

NOTE: A tank shipped under vacuum should be installed and backfilled with the vacuum intact if both of these conditions are met:

- **tank installation will begin 7 days or more after the vacuum-application date (noted on shipping documents and/or tank label)**
- **the vacuum gauge shipped with the tank reads 12 inches of mercury [40 kPa] or more.**

NOTE: All UL-labeled and ULC-labeled and potable water tanks must be pressure tested after backfill is brought close to the top of the tank.

4.9. TESTING FOR SPECIFIC TYPES OF PRESSURE-TESTABLE TANKS

NOTE: When pressure testing a tank, follow the procedures outlined in Pressure-Testing Sidebar for the specific type of tank being installed.

4.9.1. GENERAL

4.9.1.1. Prepare the tank for pressure testing in the following way:

- Assemble items needed for testing, including compressor, soap/water solution, brush, sprayer, test manifold and pressure lines.
- Set the tank in an area where the tank can be safely manipulated and observed without risking property damage or injury.
- Install the test manifold(s).
- Clean service fittings and plugs, and apply pipe thread sealant preparing the backfill bedding.
- Install gaskets, blinds and flange bolting.
- Seal service fittings, nozzles and other openings.
- Clean surfaces as required.

4.9.2. PRESSURE TESTING A SINGLE-WALL TANK

4.9.2.1. See **Pressure-Testing Sidebar** for instructions.

4.9.3. TESTING A WET DOUBLE-WALL TANK

NOTICE

Never pressurize a wet interstitial space. Doing so could result in damage to the primary tank and/or tank failure.

4.9.3.1. See **Pressure-Testing Sidebar** for instructions.

4.9.4. TESTING A DRY-MONITOR, DOUBLE-WALL TANK WITH THE INTERSTITIAL SPACE UNDER VACUUM

NOTE: The tank manufacturer is not responsible for loss of vacuum that may occur during shipping or handling, or for the fact that additional time may be required to pressure test according to instructions in the Pressure-Testing Sidebar.

4.9.4.1. A dry-monitor, double-wall tank may be shipped from the factory with the interstitial space under vacuum.

- This is an optional configuration that helps monitor the tank during shipping and handling.
- This option may expedite tank installation by shortening preinstallation testing procedures.

4.9.4.2. A tank shipped under vacuum should be installed and backfilled with the vacuum intact if both of these conditions are met:

- Tank installation will begin 7 days or more after the vacuum application date.
- The vacuum gauge shipped with the tank reads 12 inches of mercury [40 KPa] or more.

4.9.4.3. If these conditions are not met, a preinstallation is required. See the Pressure-Testing Sidebar for instructions on this tank type.

NOTE: The tank manufacturer is not responsible for loss of vacuum that may occur during shipping or handling.

4.9.4.4. Under certain field conditions, the vacuum-monitoring method may not be an accurate enough test. Such conditions include, but are not limited to:

- major changes in temperature, barometric pressure and/or altitude
- certain equipment failure – such as freezing or sticking of gauge mechanism

4.9.4.5. When in doubt, or when such conditions occur, see **Pressure-Testing Sidebar** for instructions on testing a dry, double-wall tank not under vacuum.

4.9.5. PRESSURE TESTING A DRY-MONITOR, DOUBLE-WALL TANK NOT UNDER VACUUM

4.9.5.1. See **Pressure-Testing Sidebar** for instructions.

4.9.6. PRESSURE TESTING A DRY-MONITOR, DOUBLE-WALL MULTICOMPARTMENT TANK NOT UNDER VACUUM

NOTICE

Do not connect pressure source directly to the access fitting for interstitial-space monitoring. Pressurizing the interstitial space by itself could result in damage to the primary tank and/or tank failure.

4.9.6.1. See **Pressure-Testing Sidebar** for instructions.

5: INSTALLING TANKS

5.1. GENERAL

5.1.1. Take safety precautions throughout the entire installation process. See the **Introduction**.

5.1.2. Use only approved backfill material. See **Section 1.2**.

5.1.3. Do not mix approved material together with sand or in-situ soil.

5.1.4. Do not use in-situ soil as primary backfill material.

5.1.5. Typically, all excavated in-situ soil must be replaced with primary backfill material.

5.2. DRY-HOLE INSTALLATION

5.2.1. Before beginning tank installation, take a tank diameter measurement. See **Section 1** for instructions.

5.2.2. Record this measurement as Measurement #1 on the Tank Installation Checklist.

5.2.3. Locate the excavation site according to instructions in **Section 1**.

5.2.4. Prepare the excavation according to instructions in **Section 1** and the following points:

- When preparing the excavation, allow for an anchoring system (if used) and geotextile fabric (if used). See **Section 1**.
- When preparing the excavation, allow for the appropriate depth of cover as specified in **Section 1**.
- If two or more tanks are to be installed in the same excavation hole, follow instructions in **Section 1**.
- If the tank has a bottom sump or fitting, prepare the excavation hole according to instructions in **Section 1**.

5.2.5. If an anchor slab is needed, install it now. See **Section 1**.

5.2.6. Where necessary, level the bottom of the excavation using primary backfill material, filling in any low areas. See **Section 1** for backfill requirements.

5.2.7. Geotextile fabric, if used, must be placed to separate the primary backfill material from all other in-situ soil and/or secondary backfill material. See **Section 1**.

5.2.8. If deadmen are used, see **Section 1** for information on deadmen placement.

- If deadmen are used and they are to be placed so that they are in the bedding or below the bottom of the tank, place the deadmen before preparing the backfill bedding.

5.2.9. Prepare a 12-inch-thick [30-cm-thick] smooth, level bed of approved primary backfill material on the bottom of the excavation or on top of slab. **See Section 1** for backfill requirements.

NOTICE

If anchor straps are used, bedding must be carefully leveled. Failure to follow this notice could result in straps being too short or too long, which could result in property damage.

NOTE: If the excavation has soft soil conditions or if there might be difficulties controlling water accumulation, it is acceptable to increase the bedding thickness as needed. Set the tank anchors once the bedding thickness has reached a level 12 inches [30 cm] below the tank bottom elevation.

5.2.10. See **Section 2 and Lifting-Lug Sidebar** regarding the use of lifting lugs to hoist the tank when unloading and installing it.

NOTICE

Do not set tanks directly onto a concrete slab, timbers, cradles or in-situ soil. Failure to follow this notice could result in damage to the tank.

5.2.11. Place the tank or tanks onto the bed:

- If deadmen are in place, center the tanks between them.
- Align the tanks with anchors for proper placement of anchor straps.
- As the tank is being placed, slope the tank according to site specifications.
- Sloping of tanks may affect accuracy of calibration charts.
- If a double-wall tank is sloped, the monitor should be at the low end in a tank with a dry interstitial space and at the high end in a tank with a wet interstitial space.

NOTE: We do not require that a tank be sloped. However, sloping the tank may be required by the tank owner's specifications.

5.2.12. Use the tops of the ribs to establish longitudinal level. Establish lateral level by placing the level across the top of a fitting or a manway.

NOTICE

Do not place straps between ribs (not applicable for 4-foot-diameter tanks). Failure to properly place straps could result in damage to the tank.

5.2.13. If anchor straps are to be used, install them at this time. See **Section 1** and follow these instructions:

- The locations for anchor straps are marked on tank ribs by the arrow head symbol (on the tank itself on 4-foot-diameter tanks).
- All marked anchor strap locations must have straps.
- Place a strap on each marked location and install anchoring hardware. See **Section 1.**
- Tighten each anchor strap until it is snug over the rib (over the tank itself on a 4-foot-diameter tank), but does not cause any deflection of the tank. Straps must be uniformly tight.
- A 12-inch-thick [30 cm] bedding is required under the tank, even when low-profile deadmen are used.
- After the straps have been installed and tightened, take a tank diameter measurement to check tank deflection, and record it as Measurement #2 on the Tank Installation Checklist.

NOTICE

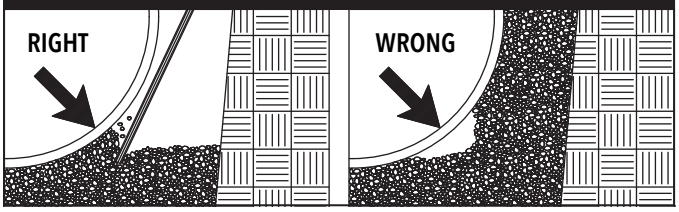
Overdeflection of the tank could result in damage to the tank.

5.2.14. Install bottom fittings and bottom piping on water/wastewater tanks at this time. See **Section 5.4**.

5.2.15. Place approximately 12 inches [30 cm] of primary backfill around the bottom of the tanks between the ribs (if present) and under the end domes.

- Use a nonmetal tamping rod long enough to reach beneath the tank to push material under the tank body and domes until solid resistance is felt. All voids must be filled and the tank must be fully supported. See **Figure 5-1**.

Figure 5-1



NOTICE

Do not use metal probes. Failure to follow this notice could result in damage to the tank.

NOTICE

Do not strike the tank with the tamping rod. Failure to heed this notice could result in damage to the tank.

5.2.16. Repeat **Point 5.2.15** with a second lift of approximately 12 inches [30 cm] of primary backfill.

5.2.17. After the second lift of material has been placed and worked under the tank, bring the backfill to the top of the tank.

- Place backfill material evenly on opposite sides of the tank so that the tank does not shift.

5.2.18. If secondary backfill material is to be used on the perimeter of the installation, it must be placed and compacted at the same time as the primary backfill material.

5.2.19. During the backfilling process, it is good practice to continue to check tank deflection.

NOTICE

Thoroughly hand-tamp backfill to eliminate all voids under the tank. Do not allow the tank to shift during the backfill procedure. If there are voids under the tank and/or the tank has shifted once backfilling has commenced, it will be necessary to remove and reinstall the tank. Failure to follow this notice could result in damage to the tank and other property damage.

5.2.20. After backfill has been brought to the top of the tank, take another tank diameter measurement. Record it as Measurement #3 in the Tank Installation Checklist, and determine whether tank deflection is within the allowable limits.

5.2.21. All UL-label, ULC-label and potable water tanks must be pressure tested after backfill is brought close to the top of the tank.

5.2.22. If additional testing (postinstallation testing for pressure-testable tanks or optional hydrostatic testing) is to be done, perform those tests now. See **Section 6** for instructions.

5.2.23. Typically, installers choose whether the tank should be ballasted at this time. See **Section 5.5** for instructions.

5.2.24. If piping and/or venting needs to be installed, complete this work now. See **Section 7** for instructions.

5.2.25. If containment sumps need to be installed, do that now. See **Section 7** for instructions.

5.2.26. Continue to backfill to grade, or to subgrade if concrete or asphalt is to be installed.

5.2.27. When the tank has been backfilled to subgrade (but before placement of slab), take the last required tank diameter measurement.

- Record it as Measurement #4 and determine whether tank deflection is within the allowable limits shown in **Table 1-6**.
- Subtract Measurement #4 from Measurement #1 and record it as the Deflection Measurement on the Tank Installation Checklist.

5.2.28. Install reinforced or unreinforced concrete/asphalt, if used, at this time. See **Section 1**.

- The cover depth must meet the appropriate minimum specified in **Section 1**.
- All backfill that is to be compacted must be compacted with a hand-guided, vibrating-plate, mechanical compactor.

NOTICE

Do not use rammer-type compactors over the top of the tank. Failure to follow this notice could result in damage to the tank and/or surrounding property.

5.2.29. If the tank has a monitoring system, after backfilling is completed and after top slab is in place (if used), perform necessary monitoring checks. See **Section 8**.

5.2.30. Complete the Tank Installation Checklist.

5.3. WET-HOLE INSTALLATION

5.3.1. Follow the dry-hole installation instructions (in **Section 5.2**) with the modifications listed.

5.3.2. Perform **Points 5.2.1 through 5.2.4** of the dry-hole installation instructions.

5.3.3. Before performing **Point 5.2.5** of the dry-hole installation instructions, pump water from the excavation hole and continue pumping to maintain minimum water level during tank installation.

- Attempt to maintain the water level below the top of the bedding materials until the tank can be fully backfilled and ballasted.

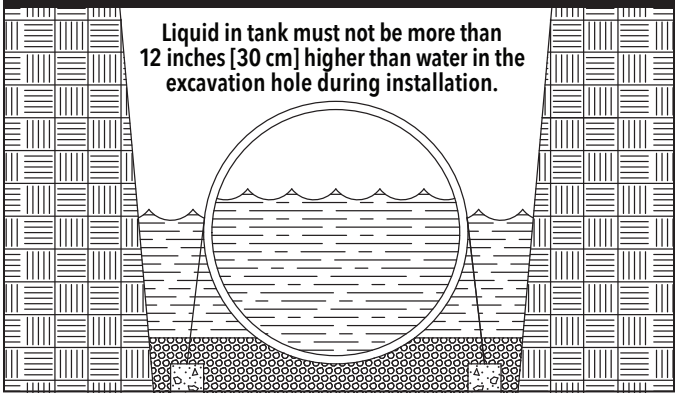
5.3.4. Proceed with **Points 5.2.5 through 5.2.9** of the dry-hole installation instructions.

5.3.5. Proceed with **Points 5.2.10 through 5.2.12** of the dry-hole installation instructions.

5.3.6. In high-water conditions, where it is not possible to maintain the water level below the top of the bedding material during the entire installation, partially ballast the tank to firmly seat the tank into the bedding material and to keep it from floating. See **Section 5.5** for instructions.

5.3.7. The ballast level in the tank must either be lower than the backfill material or less than 12 inches [30 cm] above the water level in the hole. See **Figure 5-2**.

Figure 5-2



5.3.8. Proceed with **Points 5.2.13 through 5.2.24** of the dry-hole installation instructions.

5.3.9. Ballast the tank once the backfill is even with the top of the tank. See **Section 5.5**.

5.3.10. Proceed with **Points 5.2.25 through 5.2.30** of the dry-hole installation instructions.

5.4. BOTTOM SUMPS AND FITTINGS

5.4.1. GENERAL

5.4.1.1. When handling a tank with a bottom sump or fitting, always take extra care so that the bottom sump or fitting is not damaged by contact with any other object, such as the truck bed or the ground.

NOTE: During transportation and at the jobsite, tanks with bottom sumps must be cradled to avoid damage caused by allowing the tank to rest on the sump.

5.4.1.2. When installing a large bottom sump in a water or wastewater tank, see the Large Bottom Sump Installation Instructions supplement. See the **Introduction** for details on where to obtain this supplement.

NOTICE

All connections to the tank must be flexible. Provisions must be made to accommodate movement and misalignment between the piping and the tank. Failure to do this could result in damage to the tank and/or surrounding property.

5.4.1.3. While preparing the backfill bedding, dig a hole in the bottom of the excavation that is large enough to accommodate the bottom sump or fitting.

5.4.1.4. When installing a UL-labeled or ULC-labeled tank equipped with a bottom sump, excavation and bedding must be modified to provide a 12-inch-deep [30-cm-deep] by 24-inch-diameter [61-cm-diameter] hole centered at the sump location.

5.4.1.5. The required 12 inches [30 cm] of backfill bedding on the bottom of the excavation must also be present in the excavation hole in which the bottom sump or fitting will be placed.

5.4.1.6. After the tank is placed, manually tamp backfill in the void surrounding the sump prior to adding backfill around the tank.

5.5. BALLASTING TANKS (ADDING LIQUID)

⚠WARNING

Inert the tank and use inert gases (not air) to pressure test a tank that contains or has contained flammable or combustible liquids or vapors. Failure to follow this warning could result in an explosion, and could result in death or serious injury.

⚠WARNING

If flammable or combustible product is used as ballast, exercise special care in handling. Safeguard against sparks, fire or product spills. Failure to follow this warning could result in a fire or an explosion, and could result in death or serious injury.

⚠WARNING

The tank must be adequately vented to prevent the development of vacuum or pressure when filling or emptying the tank. Failure to properly vent the tank could cause tank failure, and could result in death or serious injury.

5.5.1. GENERAL

5.5.1.1. Typically, tanks should be pressure tested before ballasting.

- Do not use atmospheric air when testing pressure-testable tanks that have held flammable or combustible product.
- Use nitrogen or other inert gas when testing these tanks.

NOTICE

If a tank is configured in such a way that one part of the tank could be full of ballast while other part(s) of the tank could be empty (such as multicompartment fuel tanks and baffled water tanks), ballast should be added evenly between tank compartments/chambers.

5.5.1.2. For most anchoring systems, a tank is not adequately protected against flotation until the tank is fully backfilled and the top slab is in place. Therefore, during the installation process, the tank should be ballasted completely after the backfill is at least 75% of the way up the tank and after postinstallation testing has been successfully completed.

5.5.1.3. Only under wet-hole conditions should ballast be added before the backfill is 75% of the way up the tank. See **Section 5.3**.

5.5.1.4. Care must be taken so that the use of ballast does not contaminate the product being stored. This is especially important for potable water, chemical and diesel exhaust fluid (DEF) tanks.

5.5.1.5. Contamination can be avoided by doing one of the following:

- Ballast the tank with a liquid compatible with the product being stored.
- Clean the tank after ballasting to eliminate any contaminating product.

⚠WARNING

Inert the tank and use inert gases (not air) to pressure test a tank that contains or has contained flammable or combustible liquids or vapors. Failure to follow this warning could result in an explosion, and could result in death or serious injury.

⚠WARNING

If flammable or combustible product is used as ballast, exercise special care in handling. Safeguard against sparks, fire or product spills. Failure to follow this warning could result in a fire or an explosion, and could result in death or serious injury.

6: POSTINSTALLATION TESTING

6.1. PRESSURE TESTING TANKS

6.1.1. If the tank is a water/wastewater tank equipped for pressure testing, follow the procedures in the Preinstallation Testing Instructions for Water/Wastewater Tanks Factory-Equipped for Pressure Testing supplement. See the **Introduction** for information on how to obtain this supplement.

6.1.2. All UL-label, ULC-label and potable water tanks must be pressure tested after backfill is brought close to the top of the tank.

6.1.3. If the tank is ballasted with water, the tank can be pressurized for pressure testing. The pressure-test pressure is:

- 5 psig [35 kPa] for 4-foot-diameter through 10-foot-diameter tanks
- 3 psig [21 kPa] for 12-foot-diameter tanks.

NOTE: When pressure testing a tank that is ballasted, depending on the ballast level in the tank, the remaining space in the tank can pressurize rapidly. See Section 4 for detailed instructions for pressurizing a tank.

6.2. OPTIONAL HYDROSTATIC TESTING

6.2.1. This optional test is typically used for water or wastewater tanks that are not pressure-testable due to the accessories on the tank.

6.2.2. Use the following procedure for this test:

- Seal off the influent and effluent piping, and any fittings that are below the tank top with watertight caps or plugs.
- Fill the tank with water to a level that is 3 inches [7.6 cm] into the access openings after the backfill is at least 75% of the way up the tank.
- Let the water stand in the tank for a minimum of 1 hour (or longer if required by applicable local codes).
- Allow sufficient time so that the water temperature stabilizes.
- If the water level drops, check to see that plugs or caps sealing off the piping are tight. Then add more water to fill air voids and return the water level back to the standard testing level.
- If the water level does not stabilize, contact eng.support@shawcor.com.

7: PIPING, VENTING AND CONTAINMENT SUMPS

7.1. INTERNAL PIPING

7.1.1. All piping must conform to all applicable codes and standards.

NOTICE

All internal piping must be at least 4 inches [10 cm] from the tank bottom. Failure to follow this notice could result in damage to the tank and/or surrounding property.

NOTICE

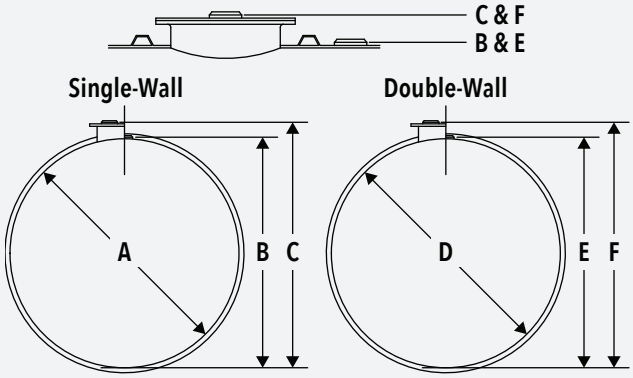
All metal fittings and other metal components must be coated to protect against corrosion. Failure to do this could result in damage to these parts, the tank and/or surrounding property.

7.1.2. For tanks equipped with manways, see table and relevant figure in **Piping and Tank Internal Diameter Sidebar** to determine the correct length for internal piping.

PIPING AND TANK INTERNAL DIAMETER SIDEBAR

TANKS WITH MANWAYS

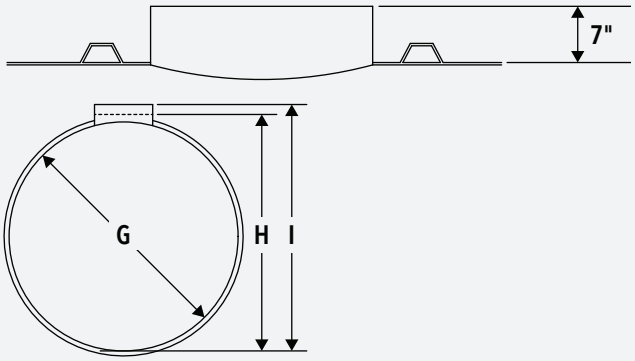
Single-Wall & Double-Wall



A. Internal diameter of a single-wall tank with a manway.
B. Dimension from the top of a service fitting to the inside bottom of a single-wall tank.
C. Dimension from the top of a service fitting on a manway cover to the inside bottom of a single-wall tank.
D. Internal diameter of a double-wall tank.
E. Dimension from the top of a service fitting to the inside bottom of a double-wall tank.
F. Dimension from the top of a service fitting on a manway cover to the inside bottom of a double-wall tank.

NOTE:
1. All fitting dimensions are measured from the top of a service fitting to the inside bottom of the tank and include striker plate clearance if applicable.
2. Interior diameters do not include striker plate clearance.
3. Nominal dimensions shown. Actual dimensions are plus or minus ½" [1.3 cm].

TANKS WITH ACCESS OPENINGS



G. Internal diameter of a single-wall tank with an access opening.
H. Dimension from the inside bottom of single-wall tank and an internal flange on an access opening.
I. Dimension from the inside bottom of a single-wall tank and the top of an access opening.

Table 7-1

Tank Diameter	A	B	C	D	E	F	G	H	I
4-foot (mfd. in US)	48" [122 cm]	49½" [126 cm]	54½" [138 cm]	48" [122 cm]	49½" [126 cm]	54½" [138 cm]	48" [122 cm]	51¼" [130 cm]	55¼" [140 cm]
4-foot (mfd. in CAN)	48¾" [124 cm]	49¼" [125 cm]	55¾" [142 cm]	48¾" [124 cm]	49½" [126 cm]	56" [142 cm]	48¾" [124 cm]	51¾" [131 cm]	55¾" [142 cm]
6-foot (mfd. in US)	71⅜" [181 cm]	73" [185 cm]	78" [198 cm]	70¾" [180 cm]	72½" [184 cm]	77¾" [197 cm]	71⅜" [181 cm]	74¾" [190 cm]	78¾" [200 cm]
6-foot (mfd. in CAN)	71½" [182 cm]	73" [185 cm]	79½" [202 cm]	71" [180 cm]	72¾" [185 cm]	79¼" [201 cm]	71½" [182 cm]	74¾" [190 cm]	78¾" [200 cm]
8-foot (mfd. in US)	91¼" [232 cm]	93" [236 cm]	98" [249 cm]	90" [229 cm]	91¾" [233 cm]	97" [246 cm]	91¼" [232 cm]	94½" [240 cm]	98½" [250 cm]
8-foot (mfd. in CAN)	97½" [248 cm]	99" [251 cm]	105½" [268 cm]	97" [246 cm]	98¾" [251 cm]	105¼" [267 cm]	97½" [248 cm]	100¾" [256 cm]	104¾" [266 cm]
10-foot (mfd. in US)	119¼" [303 cm]	121" [307 cm]	126" [320 cm]	118" [300 cm]	119¾" [304 cm]	125" [318 cm]	119¼" [303 cm]	122½" [311 cm]	126½" [321 cm]
10-foot (mfd. in CAN)	120¼" [305 cm]	121¾" [309 cm]	128¼" [326 cm]	119⅞" [304 cm]	121⅞" [310 cm]	128⅛" [325 cm]	120¼" [305 cm]	123½" [314 cm]	127½" [324 cm]
12-foot	136⅝" [347 cm]	138¼" [351 cm]	143¼" [364 cm]	135⅞" [345 cm]	137⅞"" [350 cm]	142⅞" [363 cm]	136⅝" [347 cm]	140" [356 cm]	144" [366 cm]

7.1.3. For tanks equipped with access openings, see table and relevant figure in **Piping and Tank Internal Diameter Sidebar** to determine the correct length for internal piping.

7.2. EXTERNAL PIPING

⚠WARNING

The tank must be isolated from all piping when the external piping is being pressure tested. The test pressures for external piping could cause tank failure, and could result in death or serious injury.

7.2.1. When extending monitoring or vapor-recovery piping to the surface, make sure the at-grade fittings are different from any fill fittings and will not accept standard fill hoses.

NOTICE

All connections to the tank must be flexible. Provisions must be made to accommodate movement and misalignment between the piping and the tank. Failure to do this could result in damage to the tank and/or surrounding property.

7.3. VENTING TANKS

⚠WARNING

All underground tanks/compartments shall be adequately vented to prevent the development of vacuum or pressure when filling or emptying the tank. Failure to properly vent a tank or compartment could cause tank failure, and could result in death or serious injury.

7.3.1. The primary tank is designed to operate at atmospheric pressure.

7.3.2. The tank's venting system must be adequately sized to ensure that atmospheric pressure is maintained at all times, including during filling and emptying of tank.

7.3.3. Whenever installing overfill protection, such as an alarm, an automatic shut-off device (fill pipe flapper valve) or a vent-restriction device (ball-float valve), follow the instructions provided by the manufacturer of the overfill-protection device and consult the authority having jurisdiction to determine the level at which the overfill protection should operate.

- Some jurisdictions do not allow ball-float valves.
- Consult applicable codes and regulations.

⚠WARNING

Vent-restriction devices for overfill should not be installed if owner/operator will allow pump or pressure filling of tank. Failure to follow this warning could cause tank failure, and could result in death or serious injury.

7.4. VENTING INTERSTITIAL SPACES

NOTICE

All wet monitoring systems must be vented for proper operation. Failure to do this could result in damage to the tank and/or surrounding property.

7.4.1. When the tank's interstitial space is filled with a monitoring fluid, the space must be vented. It is sufficient to drill a ¼-inch-diameter [6-mm-diameter] hole in the side or cap of the reservoir standpipe as supplied by the installer. If the groundwater level could be high enough to enter a drilled vent hole, install a vent line from the standpipe and position it above the high-water level.

7.4.2. When the interstitial space is dry, it is not necessary to vent the space to atmosphere.

7.5. INSTALLING CONTAINMENT SUMPS

7.5.1. Containment sumps come in a variety of models and sizes.

7.5.2. Instructions for the different models are found in supplemental materials. See the **Introduction** for information on where to obtain supplemental instructions.

7.5.3. The containment sump provides an enclosure for a submersible pump and a termination point for secondary piping systems.

- It provides containment of product from the pump and/or piping connections.
- It is designed to be monitored continuously using electronic sensors.

7.5.4. Before installing containment sumps:

- Consult all codes and regulations of appropriate governmental agencies to ensure proper monitoring compliance.
- Assure that all containment sumps will be isolated from traffic loads.
- Perform a visual inspection of the sump for potential shipping damage.
- Contact eng.support@shawcor.com if damage is detected.
- Check to make sure the sump is the correct length for intended burial depth.
- Obtain the specific containment sump supplement for the application installation. See **Introduction** for list of supplements.

7.5.5. Install the containment sump according to the supplemental instructions that apply. Go to xerxes.com to find additional copies of the supplements.

⚠CAUTION

Always wear eye protection and gloves when handling, grinding, cutting and attaching the containment sump unit. Failure to do so could result in minor or moderate injury.

NOTICE

Do not drop the containment sump assembly components or allow the sump body to roll. Since high winds could damage the sump components, protect and secure all pieces if windy conditions arise. Failure to follow this notice could result in damage to surrounding property.

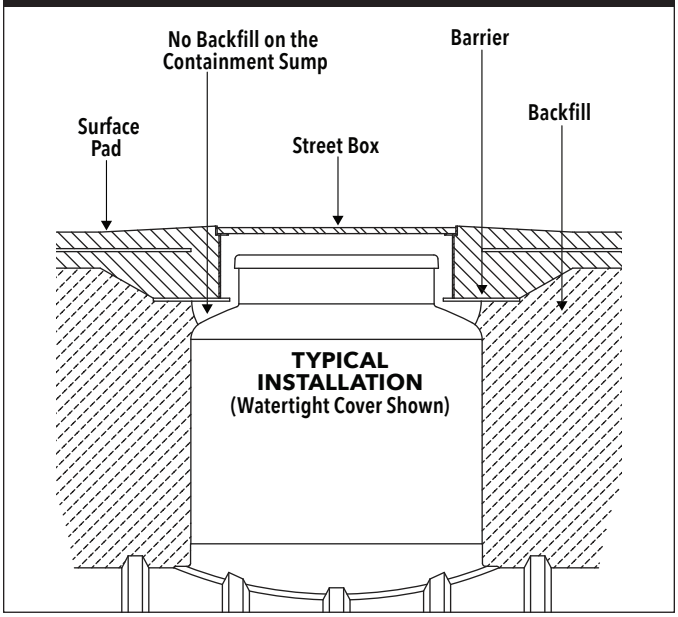
NOTICE

Make sure that no heavy objects are allowed to distort the containment sump top after final assembly. This includes the street box and concrete pad. No weight should be transferred to the tank. Failure to follow this notice could result in property damage.

7.5.6. To complete the containment sump installation:

- Backfill to the top of the containment sump system.
- Backfill around the outside edge of the containment sump, making sure that no backfill is on top of the containment sump. See **Figure 7-1**, **Backfill**.
- Isolate the containment sump from all traffic loads.
- Install a concrete form/barrier (for example, the concrete pad/street-box frame) to allow a minimum 3-inch [7.5-cm] clearance between any load-bearing item and the containment sump top.
- Typically, a sheet of plywood (or other material) is used as a barrier and is set on the backfill to ensure that there is at least a 3-inch [7.5-cm] clearance above the containment sump top. See Figure 7-1, Barrier.
- Choose a street-box size that allows enough clearance around the containment sump top opening for proper operation of the cover.

Figure 7-1



- Set the street box, and check for clearance to allow access and space to remove the watertight cover. See **Figure 7-1**, **Street Box**.
- Continue with backfill, as required, to subgrade. See **Figure 7-1**, **Backfill**.
- Maintain good drainage of water away from the access opening of the containment sump top when installing the surface pad. See **Figure 7-1**, **Surface Pad**.

8: COMPLETING INSTALLATION

8.1. TAKING DIAMETER MEASUREMENT #4.

8.1.1. When the tank has been backfilled to subgrade (but before placement of concrete or asphalt), take the last required tank diameter measurement. Record it as Measurement #4 on the Tank Installation Checklist and determine whether tank deflection is within the allowable limits shown in the *Installation Manual*.

8.1.2. In a tank with a wet interstitial space, the level of the monitoring fluid may have changed during backfill. Therefore, the level of the monitoring fluid must be checked and/or adjusted for proper level after backfill and top slab placement is completed.

8.2. MONITORING TANKS

8.2.1. It is the responsibility of the tank owner and/or operator to determine the appropriate monitoring system and method if one is to be used.

8.3. MONITORING SINGLE-WALL TANKS

8.3.1. Single-wall tank installations may require release detection monitoring, which can include inventory control, automatic tank gauging, vapor monitoring or groundwater monitoring.

8.3.2. Check with appropriate governmental agency officials for requirements in your area.

8.4. MONITORING DOUBLE-WALL TANKS

8.4.1. A double-wall tank has an interstitial space between the wall of the primary (internal) tank and the wall of the secondary (external) tank for the detection and containment of product from the primary tank.

8.4.2. A double-wall tank, as supplied, will have a minimum of 1 monitoring access fitting that provides access into the interstitial space.

8.4.3. Liquid and vapor sensors are installed through the monitoring access fitting.

- Most sensors can be installed after the tank has been backfilled to grade.
- For ease of installation, the sensor may be inserted into the monitoring access fitting before installing the monitoring riser pipe to grade.

8.5. MONITORING DOUBLE-WALL TANKS WITH A DRY INTERSTITIAL SPACE

8.5.1. A safe electronic or mechanical monitoring system should be used to detect product and incoming water.

8.5.2. The monitoring system should detect product and water at the bottom of the interstice.

- Use a drawstring to position the monitoring sensor at or near the bottom of the tank.
- If a double-wall tank is sloped, the monitor should be at the low end.

8.5.3. For liquid or vapor sensors, the monitoring access fitting may be vented to atmosphere (independent from the primary tank) or sealed.

8.6. MONITORING DOUBLE-WALL TANKS WITH A WET INTERSTITIAL SPACE

8.6.1. A double-wall tank may be shipped with a factory-installed Truchek® monitoring system, which enables the owner to have continuous monitoring or to conduct a tank-tightness test.

- Truchek meets the EPA criteria for tank-tightness testing. See the Truchek literature for more information.
- When a double-wall tank is shipped with the Truchek monitoring system, the interstitial space is typically filled with monitoring fluid at the manufacturing facility.
- Some tanks with Truchek installed may be shipped with extra monitoring fluid so the monitoring-fluid level can be topped off.
- Do not add monitoring fluid until after tank burial is completed and the monitoring system is set up.

NOTICE

All wet interstitial spaces must be vented to atmosphere. Failure to follow this notice could result in damage to the tank and/or surrounding property. See Section 7.3.

NOTICE

Monitoring fluid should not be present in the standpipe except during a Truchek test. Monitoring fluid in the standpipe could create excessive pressure on the interstitial space and could result in damage to the tank. See the Truchek literature for more information.

8.6.2. When the tank is delivered and before it is installed, check the monitoring-fluid level and record it on the shipping/receiving paperwork and Tank Installation Checklist.

- The required operating level for the monitoring fluid in the reservoir is 1/2 full. If necessary, add monitoring fluid to meet that level – but not until after the tank is buried and the monitoring system is set up.

- If monitoring fluid is not in the reservoir, contact eng.support@shawcor.com.
- In a tank with the interstice filled with monitoring fluid, using a nonmetallic standpipe in the reservoir is recommended.
- The monitoring-fluid level may fluctuate during shipping and installation.
- If a tank is sloped, the reservoir should be at the high end.

8.6.3. During the installation process, the monitoring-fluid level in the reservoir will rise naturally under various conditions:

- preinstallation pressure test
- rise in groundwater level
- backfill compaction
- ballasting
- temperature increase

8.6.4. Check and record the monitoring-fluid level during the installation process. See the Tank Installation Checklist.

8.7. SETTING THE LEVEL OF THE MONITORING FLUID

8.7.1. After completing the backfilling and placing the top slab:

- Check the level of the monitoring fluid in the reservoir and set the monitoring fluid to the proper level.
- Failure to set the monitoring-fluid level properly could lead to false alarms.

8.7.2. Once the tank is installed, the level of the monitoring fluid may fluctuate due to such things as:

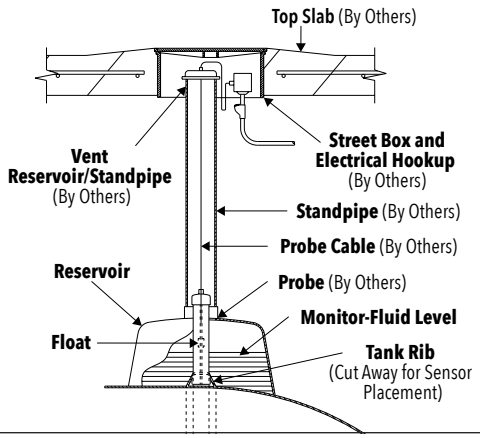
- product level
- groundwater fluctuation
- tank filling and emptying
- product-temperature variation

8.7.3. To establish the proper operating level for monitoring fluid, decide what type of monitoring probe will be used in order to determine the initial starting point for the level in the reservoir.

8.7.4. Observe the following instructions when using a probe:

- Do not raise it off the tank to meet the monitoring-fluid level.
- Keep the probe upright and in contact with the top of the tank at all times. See **Figure 8-1**.
- When using a two-sensor probe (typical probe with a high-fluid level and a low-fluid level), the starting point (the proper level for the monitoring fluid) is midway between the two sensors.
- If using something other than a two-sensor probe, use 7 inches [18 cm] from the top of the tank as the starting point for the monitoring-fluid level.
- After determining the starting point, adjust the monitoring fluid based on the product level.
- If the tank is between ¼ and ½ full of product, the proper operating level for the monitoring fluid is at the starting point.
- If the tank is between empty and ¼ full, the proper operating level for the monitoring fluid is about 1 inch [3 cm] below the starting point.
- If the tank is between ¾ full and full, the proper operating level for the monitoring fluid is about 1 inch [3 cm] above the starting point.
- Add or remove monitoring fluid to reach the proper operating level for the monitoring fluid.

Figure 8-1



8.7.5. If a Truchek test is required after installation, follow the procedures in the Truchek literature.

- After this test, reset the monitoring-fluid level to a position based on the product level.

9: OPERATING GUIDELINES

9.1. GENERAL

9.1.1. Owner must retain the *Installation Manual and Operating Guidelines* for future reference to operating guidelines.

9.1.2. In addition to this *Installation Manual*, follow all laws, regulations, codes and safety precautions of appropriate governmental agencies that pertain to underground storage tanks and/or their associated systems.

9.1.3. Consult supplemental materials (see the **Introduction**), tank brochures, separate product instructions (such as oil/water separators) and separate accessory instructions, which are available on the resource library at xerxes.com or by contacting eng.support@shawcor.com.

9.1.4. Consult the applicable limited warranty for further operating guidelines and limitations. A copy of our current limited warranty is found at xerxes.com. The tank owner should retain the limited warranty.

9.2. TEMPERATURE LIMITS FOR STORED PRODUCTS AND MATERIALS

9.2.1. Each tank is designed to store products and materials identified in the manufacturer's applicable limited warranty.

NOTICE

Products and materials must be stored in the tank appropriate for the specific product or material. Failure to follow this notice could result in damage to the tank and/or surrounding property.

NOTICE

Storing products and materials other than those identified in the manufacturer's applicable limited warranty will void the tank manufacturer's obligations under the limited warranty and could result in tank failure and/or damage to surrounding property.

9.2.2. Gaskets used must be compatible for use with tank material and fitting material, and with temperature limitations of product stored.

9.2.3. The temperature of stored products and materials must not exceed the temperature specified in the manufacturer's applicable limited warranty.

NOTICE

Introducing or storing a product or material into a tank in excess of the allowable temperature could damage the tank. Failure to follow this notice could result in damage to the tank and/or surrounding property.

NOTICE

Care should be taken not to allow accumulation of water inside the containment sumps, as it can freeze during winter conditions and result in damage to the tank and surrounding property.

9.3. ENTERING TANKS

9.3.1. Do not allow anyone to enter the tank unless it has been properly emptied and vented, and unless the person entering the tank has been trained in confined-space entry procedures and applicable OSHA regulations or appropriate Canadian federal and provincial regulations.

⚠WARNING

Improper tank entry could cause fire, explosion or asphyxiation, and could result in death or serious injury.

9.4. FILLING TANKS

9.4.1. NEVER OVERFILL THE TANK

9.4.2. If pump filling or pressure filling a tank, owner/operator must take precautions to prevent overpressurization.

⚠WARNING

Overpressurizing the tank could result in tank failure, and could result in death or serious injury.

⚠WARNING

If a tank does not have overfill protection, the vent must be unrestricted and the vent size must be equal to or greater than the fill. Failure to follow this warning could result in death or serious injury.

9.5. FILLING UL-LABELED AND ULC-LABELED TANKS

⚠WARNING

Pump filling or pressure filling of the tank is not recommended because an overfill or overpressurization could occur. Overfilling the tank while under pressure could cause tank failure even if the tank is vented properly. Failure to follow this warning could result in tank failure, and could result in death or serious injury.

9.5.1. Each time the tank is filled, the tank owner or operator must make sure the tank is properly vented. See **Section 7**.

9.5.2. The tank owner or operator must determine whether the tank has overfill protection, such as an automatic shut-off device (fill pipe flapper valve) or vent-restriction device (ball-float valve), which will close off the internal piping and reduce the tank's capacity.

- If a tank has a vent-restriction device (ball-float valve), we recommend that the tank be gravity-filled only.
- The tank owner or operator must notify whoever fills the tank if the tank has overfill protection, which reduces the tank's capacity.
- Before each tank filling, the tank owner or operator or the delivery service must determine the tank's reduced capacity due to the overfill protection.
- Then, the tank owner or operator or the delivery service must consult the instructions or guidelines provided by the installer and manufacturer of the overfill-protection device to determine how much additional product the tank can hold.

9.5.3. The tank owner or operator must ensure that the fill line and drop tube are adequately grounded to prevent static discharge during filling.

9.5.4. Initial fill rate should be controlled to limit the possibility of product sloshing.

10: DOCUMENT REVIEW

10.1. INSTALLATION MANUAL

10.1.1. After installation, tank installer must deliver the following to the tank owner and keep a copy of each:

- the *Installation Manual*
- completed Tank Installation Checklist (found at the end of this Installation Manual)

10.1.2. After installation, tank owner must retain:

- the *Installation Manual* for future reference to and compliance with operating guidelines,
- the Tank Installation Checklist
- the limited warranty
- any written waivers applicable to these instructions

10.2. TANK DATA CHARTS

10.2.1. The Tank Data Charts at the end of this document provide capacities, dimensions and weights of the most frequently sold single-wall and double-wall one-compartment tanks, and double-wall multicompartment tanks.

- **Appendix A** charts cover tanks manufactured and installed in the US.
- **Appendix B** charts cover tanks manufactured in Canada and installed in the US.
- **Appendix C** charts cover tanks manufactured and installed in Canada.

10.2.2. For information on additional tank sizes, contact eng.support@shawcor.com or go to xerxes.com.

10.2.3. For digital copies of Tank Data Charts and the Tank Installation Checklist, contact eng.support@shawcor.com or go to xerxes.com.

Access opening On a water or wastewater tank, an access opening is a non-flanged, non-bolted opening designed to provide personnel access to the interior of the tank.

Access riser An access riser on water and wastewater tanks is a large-diameter pipe – typically at least 24 inches [60 cm] – that extends vertically from an access opening at the top of a water tank to or near ground level.

Anchor strap An anchor strap is a strap used to secure the tank to the anchoring system. Only anchor straps supplied by us may be used.

Baffle On a water or wastewater tank, a baffle is a partition wall that may extend the full tank height.

Base tank On a multicompartment fuel tank, a base tank is the compartment with two convex domed endcaps that serve as bulkheads to another compartment.

Containment sumps A containment sump is a single-wall or double-wall enclosure to be installed above underground storage tanks. It is used as a termination point for piping and tank access openings.

Double-wall (DW) tank A double-wall tank is a tank with a primary (inner) wall surrounded by a secondary (outer) wall, with a monitorable space between the primary wall and the secondary wall.

Dry monitor fitting On a dry-monitored double-wall tank, a dry monitor fitting is the accessory that provides access to the interstitial space.

End compartment On a multicompartment fuel tank, an end compartment is the compartment with one convex and one concave domed endcap.

Flat Flat is a common term used to describe the area between the ribs on the outside of the tank.

In-situ soil In-situ soil is the soil naturally in place in a given site.

Interstitial space Also referred to as "interstice" or "annular space," an interstitial space is the region between any two walls of a tank or tank accessory.

Lifting lug A lifting lug is a lug attached to the tank so rigging can be secured to the lug to move the tank.

Manway A manway is the flanged fiberglass opening (typically 22-inch, 30-inch or 36-inch in diameter) that provides access to the primary tank and/or is used for multiple service fittings that are welded to a bolt-on steel manway cover.

Monitor fitting On a double-wall tank, a monitor fitting is the accessory that provides access to the interstitial space.

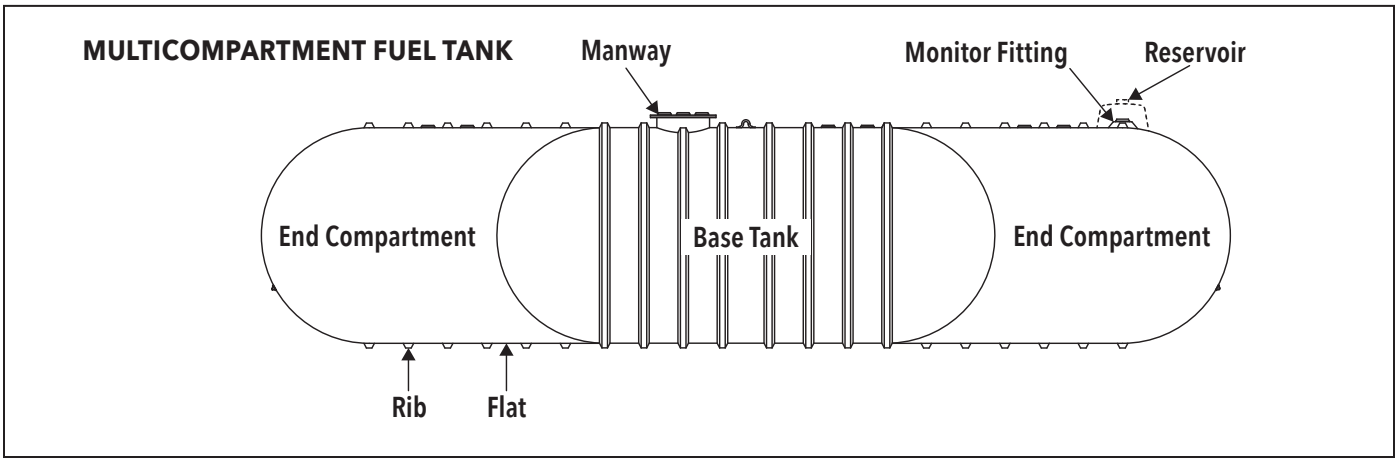
Monitoring fluid Also referred to as "brine," on a hydrostatically monitored double-wall tank, monitoring fluid is the fluid that is added to interstitial space. The monitoring fluid that we commonly use is an approximately 30% calcium chloride solution that is dyed blue to help differentiate it from other fluids.

Multicompartment (MC) tank A multicompartment tank is a fuel tank with separate compartments so that liquids can be stored secured from other compartments. This term does not apply to water or wastewater tanks with baffles.

Pressure-relief valve A pressure-relief valve is the valve that automatically opens at a set pressure to relieve pressure if it rises above the set point.

Pressure testing Pressure testing is the use of air or inert gas pressure and soapy water solution to create soap bubbles as an indication of a problem with the tank.

Primary backfill Primary backfill is rounded or crushed stone conforming to the requirements listed in **Appendix C**.



Primary tank A primary tank is the inner tank (product storage tank) of a multiple-wall tank.

Reservoir On a hydrostatically monitored double-wall tank, a reservoir is the small expansion chamber at the top of the tank used for monitoring the fluid level in the interstitial space.

Rib A rib is the fiberglass reinforcement integrally manufactured around the circumference of the tank and evenly spaced along the length of the tank.

Riser A pipe – typically at less than 10 inches [25 cm] – that extends vertically from a fitting or nozzle at the top of a water tank to or above ground level.

Secondary backfill Secondary backfill is the granular material conforming to the requirements listed in **Section 1** that may be used as an alternative to primary backfill above the tank in some conditions.

Secondary tank A secondary tank is the second wall of a multiple-wall tank. For a double-wall tank, this wall of the tank is visible from the exterior.

Single-wall (SW) tank A single-wall tank is a tank having only one wall separating its contents from the external environment.

Test manifold A test manifold is an assembly of components including pipe fittings, nipples, valves, hose, pressure gauges and a pressure-relief valve, used for controlling and monitoring pressure during a pressure test.

Truchek® Truchek® is our patented hydrostatic, tank-monitoring system for double-wall tanks. It is an easy, reliable method for true continuous leak detection and tank-tightness testing.

Torque rating Torque rating is the maximum allowable rotational load that can be applied to tighten threads. The bolt torque rating of flanged fiberglass fittings and manways on our tanks is 25 foot-pounds.

Unattached riser An unattached riser is a chamber with an open bottom above the tank, with no attachment to the tank.

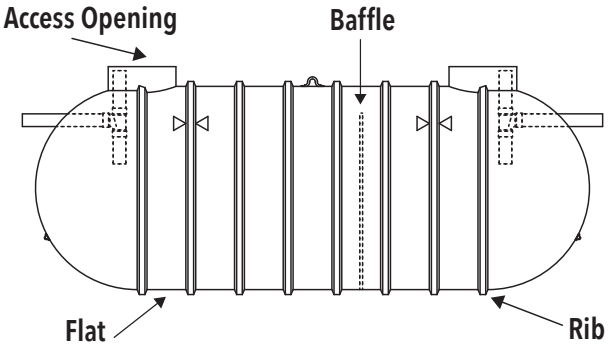
Major industry standards related to fuel tanks:

- ANSI/CAN/UL/ULC 1316-2018: Standard for Fiber Reinforced Underground Tanks for Flammable and Combustible Liquids
- CAN/ULC S615: Standard for Fiber Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids
- UL 2215: Outline of Investigation for Oil/Water Separators
- CAN/ULC S656: Standard for Oil-Water Separators

Major industry standards related to water and wastewater tanks:

- ANSI/AWWA D120: Thermosetting Fiberglass Reinforced Plastic Tanks
- IAPMO/ANSI Z1000: Prefabricated Septic Tanks
- IAPMO/ANSI Z1001: Prefabricated Gravity Grease Interceptors
- IAPMO/ANSI Z1002: Rainwater Harvesting Tanks
- NFPA 20 : Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 22: Standard for Water Tanks for Private Fire Protection
- NFPA 1142: Standard on Water Supplies for Suburban and Rural Fire Fighting
- NSF/ANSI/CAN 61: Drinking Water System Components – Health Effects

WATER TANK



TANK DATA CHARTS

The Tank Data Charts contain information on the most frequently sold tanks manufactured in the US and Canada. For data on tanks not included in these charts, go to the resource library at xerxes.com (select installation information).

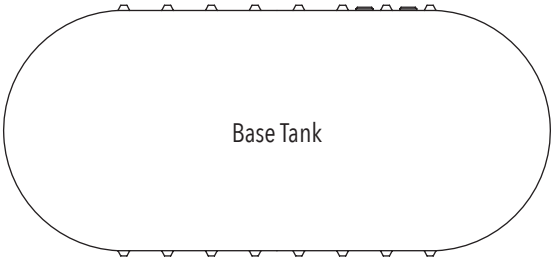
Appendix A charts	**Appendix B charts**	**Appendix C charts**
are for tanks manufactured and installed in the US.	are for tanks manufactured in Canada and installed in the US.	are for tanks manufactured and installed in Canada.

Specific Tank Type Notes	
Single-Wall Tanks	• Abbreviated SW • Water tanks with flat baffle(s) installed are not multicompartment tanks. Use one-compartment tank charts for these tanks.
Double-Wall Tanks	• Abbreviated DW • Tanks with a dry interstice use the DW Dry Weight column. • Tanks with a factory-installed Truchek® wet monitoring interstice use the DW Wet Weight column.
Multicompartment Tanks	• Abbreviated MC • The actual tank length depends on the exact configuration of a base tank and specific end compartments. • The lengths shown on the multicompartment charts reflect the estimated maximum tank length. • For the actual total length of a tank: go to the website to view drawings on specific base tanks/end compartment combinations, or see your project's tank drawing, or contact eng.support@shawcor.com.

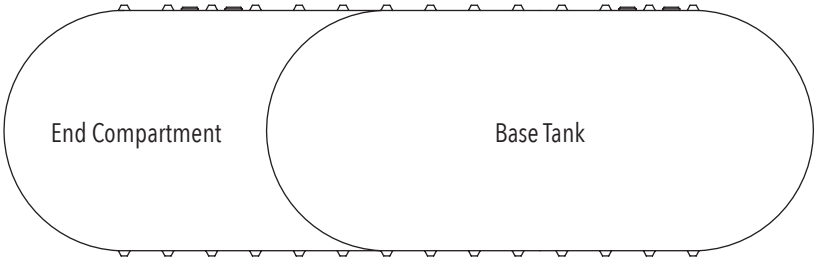
Notes For All Tank Types

- Actual capacities are reduced if an overfill-protection device is installed in the tank.
- Actual tank height may be greater than the actual tank diameter when certain accessories are installed on a tank.
- Load height during shipping may vary due to tank placement on the shipping trailer.

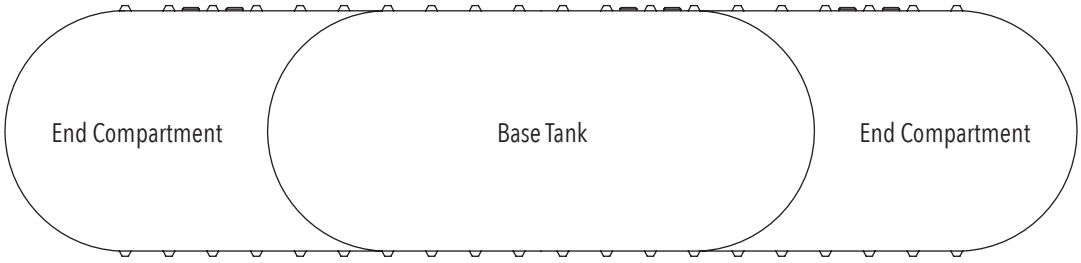
ONE-COMPARTMENT TANK



TWO-COMPARTMENT TANK



THREE-COMPARTMENT TANK



Appendix A – Tanks Manufactured and Installed in the US
One-Compartment SW and DW Tank Chart

This chart provides capacities, dimensions and weights for single-wall and double-wall one-compartment tanks. Also use this chart for the capacity of the base tank in a multicompartment tank.

Nominal Diameter [Actual Diameter] (feet/inches)	**Nominal Capacity** (gallons)	**Actual Capacity** (gallons)		**Actual Length** (feet/inches)	**Weight** (pounds)			**Anchoring Straps** (# if required)
SW & DW	**SW & DW**	**SW**	**DW**	**SW & DW**	**SW**	**DW Dry**	**DW Wet**	
4-foot [4' ½" SW] [4' 1" DW]	600	602	602	6' 11⅞" SW 7' 3½" DW	600	900	1,100	2
	700	694	694	8' 0" SW 8' 3⅝" DW	700	1,100	1,300	2
4-foot [4' 3½" SW] [4' 4" DW]	1,000	1,009	1,009	11' 3⅞" SW 11' 7½" DW	900	1,400	1,700	2
	1,500	1,449	1,449	16' 0" SW 16' 3⅝" DW	1,400	2,100	2,600	2
	2,000	2,013	2,013	22' 0" SW 22' 3⅝" DW	1,800	2,800	3,400	2
6-foot [6' 3½" SW] [6' 3½" DW]	2,000	2,376	–	13' 5¾" SW	1,300	–	–	2
	2,500	–	2,324	13' 5¾" DW	–	2,200	2,800	2
	3,000	2,973	2,910	16' 4¼" SW & DW	1,600	2,600	3,300	2
	4,000	4,131	3,789	21' 11⅛" SW 20' 8" DW	2,200	3,600	4,400	2
	5,000	5,064	4,961	26' 5" SW & DW	2,600	4,300	5,200	4
	6,000	5,960	5,840	30' 8¾" SW & DW	3,000	5,000	6,100	4
	7,000	7,154	–	36' 5¾" SW	3,500	–	–	4
	8,000	8,050	–	40' 9½" SW	4,100	–	–	4
8-foot [8' 0" SW] [8' 0" DW]	2,000	2,189	–	9' ½" SW	1,000	–	–	2
	3,000	3,271	3,249	12' 3" SW & DW	1,400	–	–	2
	4,000	4,218	4,190	15' ½" SW & DW	1,800	2,700	3,600	2
	5,000	5,165	5,089	17' 8½" SW & DW	2,200	3,200	4,200	2
	6,000	6,084	6,044	20' 6½" SW & DW	2,600	3,700	4,900	2
	7,000	6,946	6,900	23' 1" SW & DW	3,000	4,300	5,500	2
	8,000	7,950	7,899	26' ½" SW & DW	3,400	4,800	6,200	4
	9,000	8,869	8,812	28' 9" SW & DW	3,800	5,400	6,800	4
	10,000	9,816	9,753	31' 6½" SW & DW	4,200	5,900	7,500	4
	11,000	10,763	10,694	34' 4" SW & DW	4,700	6,400	8,100	4
	12,000	11,682	11,608	37' ½" SW & DW	5,100	7,000	8,800	4
	13,000	13,081	13,000	41' 2" SW & DW	5,600	7,600	9,500	6
	14,000	14,028	13,941	43' 11½" SW & DW	6,000	8,200	10,200	6
	15,000	14,975	14,881	46' 9" SW & DW	6,600	9,100	11,200	6
10-foot [10' 4" SW] [10' 4" DW]	7,000	7,358	7,258	15' 11¼" SW & DW	3,100	–	–	4
	8,000	8,160	8,050	17' 3¾" SW & DW	3,500	3,900	5,200	4
	9,000	8,961	8,841	18' 8¼" SW & DW	3,800	4,200	5,600	4
	10,000	10,563	10,420	21' 5¼" SW & DW	4,500	4,900	6,400	4
	11,000	11,364	11,210	22' 9¾" SW & DW	4,800	5,200	6,800	4
	12,000	12,068	11,904	24' ¼" SW & DW	5,100	5,600	7,200	4
	13,000	12,966	12,790	25' 6¾" SW & DW	5,500	5,900	7,600	4
	14,000	13,767	13,580	26' 11¼" SW & DW	5,800	6,300	8,000	4
	15,000	15,248	15,041	29' 5¾" SW & DW	6,600	7,000	8,900	4
	16,000	16,851	16,621	32' 2¾" SW & DW	7,200	7,700	9,700	6
	17,000	17,652	17,412	33' 7¼" SW & DW	7,600	8,000	10,100	6
	18,000	18,453	18,202	34' 11¾" SW & DW	7,900	8,400	10,500	6

Nominal Diameter [Actual Diameter] (feet/inches)	Nominal Capacity (gallons)	Actual Capacity (gallons)		Actual Length (feet/inches)	Weight (pounds)			Anchoring Straps (# if required)
SW & DW	SW & DW	SW	DW	SW & DW	SW	DW Dry	DW Wet	
10-foot [10' 4" SW] [10' 4" DW]	19,000	19,254	18,992	36' 4¼" SW & DW	8,200	8,700	10,900	6
	20,000	20,055	19,782	37' 8¾" SW & DW	8,600	9,000	11,300	6
	21,000	21,779	21,481	40' 8¼" SW & DW	9,400	10,200	12,600	8
	22,000	22,580	22,271	42' ¾" SW & DW	9,700	10,500	13,000	8
	23,000	23,381	23,061	43' 5¼" SW & DW	10,100	10,800	13,400	8
	24,000	24,181	23,851	44' 9¾" SW & DW	10,400	11,200	13,800	8
	25,000	25,783	25,431	47' 6¾" SW & DW	11,100	11,800	14,600	8
	26,000	26,540	26,222	48' 11¼" SW & DW	11,400	12,200	15,000	8
	27,000	27,385	27,012	50' 3¾" SW & DW	11,700	12,500	15,500	8
	28,000	28,141	27,802	51' 8¼" SW & DW	12,100	12,900	15,900	8
	29,000	29,741	29,382	54' ¾" SW & DW	12,800	13,500	16,700	8
	30,000	30,590	30,172	55' 9¾" SW & DW	13,200	14,000	17,200	10
	31,000	32,142	31,752	58' 6¾" SW & DW	13,900	14,700	18,100	10
	32,000	32,942	32,542	59' 11¼" SW & DW	14,200	15,000	18,500	10
	33,000	33,794	33,332	61' 3¾" SW & DW	14,600	15,400	18,900	10
	34,000	34,543	34,122	62' 8¼" SW & DW	14,900	15,700	19,300	10
	35,000	35,397	34,912	64' ¾" SW & DW	15,400	16,500	20,100	12
	36,000	36,944	36,492	66' 9¾" SW & DW	16,000	17,200	20,900	12
	37,000	37,744	37,283	68' 2¼" SW & DW	16,400	17,500	21,300	12
	38,000	38,544	38,073	69' 6¾" SW & DW	16,700	17,800	21,700	12
	39,000	40,145	39,653	72' 3¾" SW & DW	17,400	18,500	22,600	12
	40,000	41,004	40,443	73' 8¼" SW & DW	17,900	19,000	23,100	14
12-foot [11' 11" SW] [11' 11" DW]	20,000	20,781	20,638	29' 4" SW & DW	9,200	14,000	16,700	6
	25,000	25,541	25,381	35' 7" SW & DW	10,800	16,600	19,700	8
	30,000	31,253	31,072	43' 1" SW & DW	13,100	19,900	23,500	10
	35,000	36,013	35,815	49' 4" SW & DW	14,700	22,500	26,500	12
	40,000	39,821	39,609	54' 4" SW & DW	16,100	24,600	28,900	12
	45,000	45,131	44,352	60' 7" SW & DW	18,000	27,400	32,100	16
	48,000	48,389	48,146	65' 7" SW & DW	19,300	29,500	34,500	18
	50,000	50,293	50,044	68' 1" SW & DW	20,000	30,500	35,700	18

Appendix A – Tanks Manufactured and Installed in the US
Multicompartment DW Tank Chart

This chart provides capacities, dimensions and weights for two-compartment and three-compartment tanks. When determining the weight of a multicompartment tank, select the tank size given the total nominal capacity of all compartments combined.

Nominal Diameter [Actual Diameter] (feet/inches)	Nominal Total Capacity (gallons)	Estimated Maximum Tank Length (feet/inches)	Total Weight: Two-Compartment Tanks (pounds)		Total Weight: Three-Compartment Tanks (pounds)	
DW	DW	DW	DW Dry	DW Wet	DW Dry	DW Wet
6-foot [6' 3½" DW]	4,000	23' 6½"	4,000	4,900	–	–
	5,000	26' 5"	4,700	5,700	–	–
	6,000	30' 8¾"	5,400	6,600	–	–
	7,000	36' 5¾"	6,200	7,500	–	–
	8,000	40' 9½"	7,100	8,600	7,500	9,100
	9,000	45' 1½"	7,900	9,500	8,300	10,000
	10,000	50' 10¼"	8,600	10,300	9,000	10,800
	11,000	53' 8¾"	9,700	11,500	10,100	12,000
	12,000	59' 5¾"	10,400	12,300	10,800	12,800

Nominal Diameter [Actual Diameter] (feet/inches)	Nominal Total Capacity (gallons)	Estimated Maximum Tank Length (feet/inches)	Total Weight: Two-Compartment Tanks (pounds)		Total Weight: Three-Compartment Tanks (pounds)	
DW	DW	DW	DW Dry	DW Wet	DW Dry	DW Wet
8-foot [8' 0" DW]	6,000	20' 7½"	4,300	5,800	–	–
	7,000	23' 5"	4,900	6,400	–	–
	8,000	26' 2½"	5,400	7,100	6,000	8,000
	9,000	28' 11"	6,000	7,700	6,600	8,600
	10,000	31' 9½"	6,500	8,400	7,100	9,300
	11,000	34' 7"	7,000	9,000	7,600	9,900
	12,000	38' 8"	7,600	9,700	8,200	10,600
	13,000	40' 0"	8,200	10,400	8,800	11,300
	14,000	42' 9½"	8,800	11,100	9,400	12,000
	15,000	46' 11¾"	9,700	12,100	10,300	13,000
	16,000	48' 5½"	10,200	12,800	10,800	13,700
	17,000	51' 0"	10,500	13,100	11,100	14,000
	18,000	53' 9½"	11,000	13,700	11,600	14,600
	19,000	56' 7"	11,600	14,400	12,200	15,300
	20,000	59' 5½"	12,400	15,400	13,000	16,300
	21,000	62' 2"	12,900	16,000	13,500	16,900
	22,000	64' 11½"	13,200	16,300	13,800	17,200
	23,000	70' 5¾"	13,800	17,100	14,400	18,000
	24,000	74' 11¾"	14,400	17,700	15,000	18,600
	25,000	76' ¾"	15,200	18,700	15,800	19,600
10-foot [10' 5½" DW]	12,000	25' 6¾"	6,600	8,600	–	–
	13,000	26' 11¼"	6,900	9,000	–	–
	14,000	28' 3¾"	7,300	9,400	–	–
	15,000	29' 8½"	8,000	10,300	9,000	11,700
	16,000	32' 5¼"	8,700	11,100	9,700	12,500
	17,000	33' 9¾"	9,000	11,500	10,000	12,900
	18,000	35' 2¼"	9,400	11,900	10,400	13,300
	19,000	36' 4¾"	9,700	12,300	10,700	13,700
	20,000	39' 3¾"	10,000	12,700	11,000	14,100
	21,000	40' 5¾"	11,200	14,000	12,200	15,400
	22,000	41' 10¾"	11,500	14,400	12,500	15,800
	23,000	43' 5¼"	11,800	14,800	12,800	16,200
	24,000	46'-2¼"	12,200	15,200	13,200	16,600
	25,000	47' 4¼"	12,800	16,000	13,800	17,400
	26,000	48' 9¼"	13,200	16,400	14,200	17,800
	27,000	51' 5¾"	13,500	16,900	14,500	18,300
	28,000	51' 6¼"	13,900	17,300	14,900	18,700
	29,000	54' 2¾"	14,500	18,100	15,500	19,500
	30,000	55' 7¼"	15,000	18,600	16,000	20,000
	31,000	56' 11¾"	15,700	19,500	16,700	20,900
	32,000	59' 8¾"	16,000	19,900	17,000	21,300
	33,000	61' 1"	16,400	20,300	17,400	21,700
	34,000	62' 5¾"	16,700	20,700	17,700	22,100
	35,000	63' 10"	17,500	21,500	18,500	22,900
	36,000	65' 2¾"	18,200	22,300	19,200	23,700
	37,000	67' 11¾"	18,500	22,700	19,500	24,100
	38,000	69' 6¾"	18,800	23,100	19,800	24,500
	39,000	70' 11¼"	19,550	24,000	20,500	25,400
	40,000	73' 8¼"	20,000	24,500	21,000	25,900

Appendix B – Tanks Manufactured in Canada and Installed in the US
One-Compartment SW and DW Tank Chart

This chart provides capacities, dimensions and weights for single-wall and double-wall one-compartment tanks. Also use this chart for the capacity of the base tank in a multicompartment tank.

Nominal Diameter [Actual Diameter] (feet/inches)	**Nominal Capacity** (gallons)	**Actual Capacity** (gallons)		**Actual Length** (feet/inches)	**Weight** (pounds)			**Anchoring Straps** (# if required)
SW & DW	**SW & DW**	**SW**	**DW**	**SW & DW**	**SW**	**DW Dry**	**DW Wet**	
4-foot [4' 1 3/16" SW] [4' 1 7/16" DW]	600	610	671	7' 4 9/16" SW 7' 4 13/16" DW	700	800	1,000	2
	750	773	773	8' 3 3/16" SW	700	900	1,100	2
	1,000	1,036	1,086	11' 1 3/8" SW 11' 4 1/4" DW	800	1,000	1,300	2
	1,300	1,340	1,340	14' 3 15/16" SW	1,100	1,300	1,700	2
6-foot [6' 3 1/4" SW] [6' 3 1/4" DW]	1,500	1,794	–	10' 8" SW	800	–	–	2
	2,000	2,650	–	14' 9 1/4" SW	900	–	–	2
	2,500	–	2,635	14' 10 1/4" DW	1,100	–	–	2
	3,000	3,045	3,008	16' 8" SW & DW	1,200	2,100	2,600	2
	4,000	4,036	4,038	21' 5" SW 21' 8" DW	1,700	2,900	3,400	2
	5,000	5,335	4,900	27' 7 3/4" SW 25' 10 1/4" DW	2,000	3,500	4,100	4
	6,000	6,609	6,002	33' 9" SW 31' 2 1/2" DW	2,400	4,200	4,800	4
8-foot [8' 6" SW] [8' 6" DW]	4,000	3,982	4,336	13' 3/4" SW 14' 3/4" DW	1,600	2,200	2,700	2
	5,000	5,387	4,873	16' 8 1/4" SW 15' 5 1/2" DW	1,800	2,400	2,900	2
	6,000	6,041	5,993	18' 4 1/2" SW & DW	2,200	2,900	3,500	2
	7,000	6,631	7,194	19' 10 3/4" SW 21' 6" DW	2,500	3,400	4,000	2
	8,000	8,902	8,090	23' 8" SW 23' 10" DW	2,900	3,900	4,600	4
	9,000	9,271	9,163	26' 8 1/2" SW 26' 7 1/2" DW	3,300	4,300	5,100	4
	10,000	9,780	9,699	28' 1/4" SW & DW	3,500	4,600	5,400	4
	11,000	10,797	10,924	30' 7 3/4" SW 31' 2 1/2" DW	3,900	5,100	6,000	4
	12,000	12,907	11,996	34' SW & DW	4,300	5,600	6,500	4
	13,000	13,236	13,069	36' 11 1/4" SW 36' 9 1/2" DW	4,700	6,000	7,100	4
	14,000	14,528	14,021	40' 3 1/4" SW & DW	5,100	6,700	7,700	6
	15,000	15,222	15,094	42' 3/4" SW & DW	5,500	7,200	8,300	6
	16,000	16,086	16,166	44' 3 1/2" SW 44' 10 1/4" DW	5,900	7,600	8,800	6
	17,000	17,386	17,239	47' 7 3/4" SW & DW	6,300	8,100	9,400	6
10-foot [10' 5 1/2" SW] [10' 5 1/2" DW]	8,000	8,500	8,430	16' 1 3/4" SW & DW	3,900	4,300	5,000	4
	9,000	9,325	9,247	17' 6 1/2" SW & DW	4,200	4,600	5,400	4
	10,000	10,144	10,065	18' 11 1/4" SW & DW	4,500	5,000	5,800	4
	11,000	11,166	11,073	20' 7 7/8" SW & DW	4,900	5,300	6,100	4
	12,000	11,991	11,897	22' 3/4" SW & DW	5,200	5,700	6,500	4
	13,000	13,401	13,288	24' 5 1/4" SW & DW	5,800	6,300	7,300	4
	14,000	15,014	14,253	27' 2" SW 26' 1" DW	6,100	6,700	7,600	4
	15,000	15,199	15,071	27' 5 3/4" SW & DW	6,400	7,000	8,000	5
	16,000	16,073	15,938	28' 11 1/2" SW & DW	6,800	7,300	8,400	5

Nominal Diameter [Actual Diameter] (feet/inches)	Nominal Capacity (gallons)	Actual Capacity (gallons)		Actual Length (feet/inches)	Weight (pounds)			Anchoring Straps (# if required)
SW & DW	SW & DW	SW	DW	SW & DW	SW	DW Dry	DW Wet	
10-foot [10' 5½" SW] [10' 5½" DW]	17,000	17,546	17,525	31' 5" SW 31' 8" DW	7,400	8,000	9,200	5
	18,000	18,499	18,343	33' ¾" SW & DW	7,700	8,400	9,500	6
	19,000	19,115	18,953	34' 1¼" SW & DW	8,000	8,700	9,900	6
	20,000	20,100	19,930	35' 9¼" SW & DW	8,300	9,000	10,300	6
	21,000	21,418	21,236	38' SW & DW	8,700	9,600	10,900	6
	22,000	22,575	22,384	39' 11½" SW & DW	9,300	10,300	11,600	7
	23,000	22,748	22,555	40' 3" SW & DW	9,400	10,400	11,700	7
	24,000	24,299	24,093	42' 10½" SW & DW	10,000	11,000	12,400	7
	25,000	25,297	25,106	44' 7¼" SW & DW	10,300	11,300	12,800	8
	26,000	26,147	25,925	46' SW & DW	10,600	11,600	13,200	8
	27,000	26,775	26,547	47' ¾" SW & DW	10,900	12,000	13,500	8
	28,000	28,622	28,378	50' 2¼" SW & DW	11,600	12,700	14,300	10
	29,000	29,447	29,196	51' 7" SW & DW	11,900	13,000	14,700	10
	30,000	30,173	29,916	52' 9¾" SW & DW	12,200	13,300	15,100	10
	35,000	35,308	–	61' 6" SW	14,100	–	–	12
	40,000	40,468	–	70' 2¾" SW	16,100	–	–	14

Appendix B – Tanks Manufactured in Canada and Installed in the US Multicompartment DW Tank Chart

This chart provides weights for two-compartment and three-compartment tanks. When determining the weight of a multicompartment tank, select the tank size given the total nominal capacity of all compartments combined.

Nominal Diameter [Actual Diameter] (feet/inches)	Nominal Total Capacity (gallons)	Estimated Maximum Tank Length (feet/inches)	Total Weight: Two-Compartment Tanks (pounds)		Total Weight: Three-Compartment Tanks (pounds)	
DW	DW	DW	DW Dry	DW Wet	DW Dry	DW Wet
6-foot [6' 3¼" DW]	3,000	18' ¼"	2,400	3,100	–	–
	4,000	22' 2½"	3,200	3,900	–	–
	5,000	26' 4¼"	3,800	4,600	–	–
	6,000	31' 3¼"	4,500	5,300	–	–
8-foot [8' 6" DW]	8,000	24' 5½"	4,400	5,300	–	–
	9,000	27' 2"	4,800	5,800	–	–
	10,000	28' 6¾"	5,100	6,100	5,600	6,800
	11,000	31' 5¾"	5,600	6,700	6,100	7,400
	12,000	34' ½"	6,100	7,200	6,600	7,900
	13,000	37' 2"	6,500	7,800	7,000	8,500
	14,000	39' 9¾"	7,200	8,400	7,700	9,100
	15,000	42' 1¾"	7,700	9,000	8,200	9,700
	16,000	44' 6¾"	8,100	9,500	8,600	10,200
	17,000	47' 4½"	8,600	10,100	9,100	10,800
10-foot [10' 5½" DW]	14,000	26' 8½"	8,200	9,500	9,700	11,400
	15,000	28' 1¼"	8,500	9,900	10,000	11,800
	16,000	29' 6"	8,800	10,300	10,300	12,200
	17,000	31' 3¼"	9,500	11,100	11,000	13,000
	18,000	33' 5½"	9,900	11,400	11,400	13,300
	19,000	34' 10¼"	10,200	11,800	11,700	13,700
	20,000	36' 3"	10,500	12,200	12,000	14,100
	21,000	37' 7¾"	11,100	12,800	12,600	14,700
	22,000	39' 4½"	11,800	13,500	13,300	15,400

Nominal Diameter [Actual Diameter] (feet/inches)	**Nominal Total Capacity** (gallons)	**Estimated Maximum Tank Length** (feet/inches)	**Total Weight: Two-Compartment Tanks** (pounds)		**Total Weight: Three-Compartment Tanks** (pounds)	
DW	**DW**	**DW**	**DW Dry**	**DW Wet**	**DW Dry**	**DW Wet**
10-foot [10' 5½" DW]	23,000	41' 9¾"	11,900	13,600	13,400	15,500
	24,000	43' 7"	12,500	14,300	14,000	16,200
	25,000	44' 11¾"	12,800	14,700	14,300	16,600
	26,000	46' 4½"	13,100	15,100	14,600	17,000
	27,000	48' 6¾"	13,500	15,400	15,000	17,300
	28,000	50' 9"	14,200	16,200	15,700	18,100
	29,000	52' 1¾"	14,500	16,600	16,000	18,500
	30,000	53' 6½"	14,800	17,000	16,300	18,900

Appendix C – Tanks Manufactured and Installed in Canada
One-Compartment SW and DW Tank Chart

This chart provides capacities, dimensions and weights for single-wall and double-wall one-compartment tanks. Also use this chart for the capacity of the base tank in a multicompartment tank.

Nominal Diameter [Actual Diameter] (millimeters)	**Nominal Capacity** (liters)	**Actual Capacity** (liters)		**Actual Length** (millimeters)	**Weight** (kilograms)			**Anchoring Straps** (# if required)
SW & DW	**SW & DW**	**SW**	**DW**	**SW & DW**	**SW**	**DW Dry**	**DW Wet**	
4-foot [1,249 mm SW] [1,249 mm DW]	2,500	2,538	2,538	2,295 SW 2,303 DW	300	400	500	2
	3,900	3,924	3,924	3,387 SW 3,395 DW	400	500	600	2
	5,000	5,073	5,073	4,368 SW 4,380 DW	500	600	700	2
6-foot [1,910 mm SW] [1,910 mm DW]	10,000	10,030	10,006	4,502 SW 4,520 DW	500	900	1,100	2
	15,000	15,277	15,283	6,528 SW 6,604 DW	800	1,300	1,600	4
	20,000	20,196	20,040	8,426 SW 8,465 DW	1,000	1,700	2,000	4
	25,000	25,015	25,038	10,287 SW 10,420 DW	1,300	2,200	2,500	4
8-foot [2,590 mm SW] [2,590 mm DW]	15,000	15,073	15,019	3,981 SW 3,994 DW	600	900	1,100	2
	20,000	20,391	20,472	5,086 SW 5,137 DW	900	1,200	1,500	2
	25,000	25,097	25,018	6,064 SW 6,090 DW	1,100	1,400	1,700	2
	30,000	30,629	30,620	7,214 SW 7,264 DW	1,300	1,700	2,100	4
	35,000	35,091	35,014	8,141 SW 8,185 DW	1,500	2,000	2,300	4
	40,000	40,867	40,772	9,341 SW 9,392 DW	1,800	2,300	2,700	4
	45,000	45,788	45,405	10,363 SW & DW	1,900	2,500	3,000	4
	50,000	50,097	50,009	11,259 SW 11,328 DW	2,100	2,700	3,200	4
	60,000	60,885	60,371	13,500 SW & DW	2,600	3,400	3,900	6
	65,000	65,806	65,247	14,522 SW & DW	2,900	3,700	4,300	6
10-foot [3,188 mm SW] [3,188 mm DW]	50,000	50,723	50,301	7,449 SW & DW	2,600	2,900	3,300	4
	55,000	56,829	56,348	8,280 SW & DW	2,900	3,200	3,600	4
	60,000	60,838	60,329	8,827 SW & DW	3,100	3,300	3,800	5
	65,000	66,338	65,780	9,576 SW & DW	3,400	3,600	4,200	5
	70,000	72,351	71,740	10,395 SW & DW	3,600	3,900	4,500	6
	75,000	76,079	75,436	10,903 SW & DW	3,800	4,100	4,700	6
	80,000	81,067	80,378	11,582 SW & DW	4,000	4,400	4,900	6
	85,000	86,101	85,370	12,268 SW & DW	4,200	4,700	5,300	7
	90,000	91,973	91,191	13,068 SW & DW	4,500	5,000	5,600	7
	100,000	101,342	100,484	14,345 SW & DW	5,000	5,400	6,100	8
	110,000	111,457	110,512	15,723 SW & DW	5,400	5,400	6,100	9
	115,000	114,207	–	16,097 SW	5,500	5,900	6,700	10
	135,000	133,643	–	18,745 SW	6,400	–	–	12
	150,000	153,173	–	21,406 SW	7,300	–	–	14

Appendix C – Tanks Manufactured and Installed in Canada
Multicompartment DW Tank Chart

This chart provides weights for two-compartment and three-compartment tanks. When determining the weight of a multicompartment tank, select the tank size given the total nominal capacity of all compartments combined.

Nominal Diameter [Actual Diameter] (millimeters)	**Nominal Total Capacity** (liters)	**Estimated Maximum Tank Length** (millimeters)	**Total Weight: Two-Compartment Tanks** (kilograms)		**Total Weight: Three-Compartment Tanks** (kilograms)	
DW	**DW**	**DW**	**DW Dry**	**DW Wet**	**DW Dry**	**DW Wet**
6-foot [1,910 mm DW]	15,000	6,642	1,400	1,800	–	–
	20,000	8,446	1,800	2,200	–	–
	25,000	10,515	2,300	2,700	–	–
8-foot [2,590 mm DW]	35,000	8,303	2,200	2,600	–	–
	40,000	9,393	2,500	3,000	–	–
	45,000	10,428	2,700	3,300	–	–
	50,000	11,518	2,900	3,500	3,100	3,800
	55,000	12,553	3,300	3,900	3,500	4,200
	60,000	13,639	3,600	4,200	3,800	4,500
	65,000	14,663	3,900	4,600	4,100	4,900
10-foot [3,188 mm DW]	70,000	10,379	4,600	5,300	–	–
	75,000	11,103	4,800	5,500	–	–
	80,000	11,630	5,100	5,700	–	–
	85,000	12,617	5,400	6,100	–	–
	90,000	13,218	5,700	6,400	6,400	7,200
	100,000	14,733	6,100	6,900	6,800	7,700
	110,000	16,114	6,600	7,500	7,300	8,300

TANK INSTALLATION CHECKLIST

TO INSTALLER: After tank installation, deliver the *Installation Manual* with the completed Tank Installation Checklist to the tank owner. Retain a copy of each for your records.

TO OWNER: After installation, retain the limited warranty, the *Installation Manual* and completed Tank Installation Checklist for future reference and to facilitate any warranty claim.

INSTALLATION DATE(S): _____ **PERSON COMPLETING FORM:** _____

INSTALLATION ADDRESS: _____

TANK INFORMATION	TANK #1	TANK #2	TANK #3	TANK #4
Tank type – Single-Wall (SW), Double-Wall (DW)				
Tank Usage (Fuel) – Fuel, DEF, Pipeline Sump				
Tank Usage (Water) – Potable Water, Water Collection				
Tank Usage (Wastewater) – Grease Interceptor, Septic, Industrial Wastewater/Chemical				
Tank Usage (Oil/Water Separator)				
Nominal Tank Diameter – give in feet				
Nominal Tank Capacity – give in gallons or liters (and note which)				
If applicable, UL/ULC # (read from tank label) – yes or no				

SITE INFORMATION (See Section 1)	TANK #1	TANK #2	TANK #3	TANK #4
Primary backfill meets Appendix C requirements – yes or no				
Secondary backfill material will be used – yes or no				
Secondary backfill meets our requirements – yes or no				
Geotextile will be used – yes or no				
Excavation – shored or not shored				
Tank will see traffic loads (H20 or HS20) – yes or no				
Hole condition – dry or wet				
Anchoring system will be used – yes or no				
If applicable, anchoring system used – deadmen or anchor slab				

PREINSTALLATION INSPECTION AND TESTING (See Sections 3 and 4)		TANK #1	TANK #2	TANK #3	TANK #4
Visual Inspection	Shipping damage – yes or no				
	Loss of vacuum – yes or no				
	Monitoring fluid visible on interior of tank – yes or no				
	Monitoring fluid visible on exterior of tank – yes or no				
Requirements met for double-wall tanks shipped under interstitial vacuum – yes or no. If yes, record the value.					
Record fluid level in reservoir for double-wall wet tanks					
If required, tank passed pressure/soap test – yes or no					

INSTALLING TANKS (See Sections 5 and 7)	TANK #1	TANK #2	TANK #3	TANK #4
Record tank diameter measurement #1 (before installation)				
Record final backfill bedding depth under tank – inches or centimeters				
Record final tank spacing between tanks – inches or centimeters				
Record final tank spacing from tank endcap to excavation walls – inches or centimeters				
If applicable, deadmen used – factory-supplied or other				
If applicable, anchoring hardware – factory-supplied or other				
Record diameter measurement #2 (after straps are installed)				
Subtract diameter measurement #2 from #1 and record				
Deflection measurement meets **Table 1-6** requirements – yes or no				
Voids under tank between ribs and under domes filled with backfill and tamped – yes or no				
Backfill placement and compaction meet requirements – yes or no				
Piping connections meet requirements – yes or no				
Fittings and other metal components are coated for corrosion protection – yes or no				
Record diameter measurement #3 (after backfilling to top of tank is complete)				
Subtract diameter measurement #3 from #1 and record				
Deflection measurement meets **Table 1-6** requirements – yes or no				
Tank was ballasted prior to bringing backfill to top of tank – yes or no				

After backfilling is brought to top of tank (See Sections 5, 6 and 8)

Tank was ballasted after bringing backfill to top of tank – yes or no				
Postinstallation tests were conducted for pressure-testable tanks – yes or no				
If applicable, optional hydrostatic test was performed – yes or no				
If applicable, containment sump test was successful – yes or no				
Record final depth of backfill over tank – give in inches or centimeters				
Record diameter measurement #4 (after backfilling is brought to subgrade)				
Subract diameter measurement #4 from #1 and record				
Final deflection measurement meets requirements of **Table 1-6** – yes or no				
If applicable, type of surface pad used – concrete or asphalt				
If applicable, thickness of surface pad used – give in inches or centimeters and note which type				
If applicable, record monitoring fluid level when backfilling & top slab installation are complete				

SITE SKETCH (Indicate specifics of tank installation.)

ADDITIONAL NOTES
Note any variations and/or deviations from instructions (and attach written authorizations):

VERIFYING SIGNATURES	
CONTRACTOR	**TANK OWNER/REPRESENTATIVE**
I verify that this information is a true record of the installation of the tanks listed here.	I verify that this information is a true record of the installation of the tanks listed here, and that I have received a copy of the *Installation Manual* and this Tank Installation Checklist.
Name:	**Name:**
Telephone:	**Telephone:**
Email:	**Email:**
Address:	**Address:**
Signature:	**Signature:**
Date:	**Date:**

TO INSTALLER: After tank installation, deliver the *Installation Manual* with the completed Tank Installation Checklist to the tank owner. Retain a copy of each for your records.

TO OWNER: After installation, retain the limited warranty, the *Installation Manual* and completed Tank Installation Checklist for future reference and to facilitate any warranty claim.

MULTIPLE FACILITIES FOR TIMELY MANUFACTURING AND DELIVERY

With six manufacturing facilities in North America, no matter where customers need fiberglass tanks and accessories shipped, a manufacturing facility is not far away. No other tank producer offers this kind of manufacturing capability in North America.

Xerxes is a product line of Shawcor Ltd. Headquartered in Toronto, Canada, Shawcor is a leading global company specializing in products, services and solutions for the water, energy, infrastructure and transportation markets. We continually pursue sustainable solutions that protect the environment, conserve resources and extend asset life.



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XERXES® BY SHAWCOR

FlexWORKS
BY OPW FUELING CONTAINMENT SYSTEMS

Flexible Piping Installation Instructions

Publication: PII-0001
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Supercedes: 06-17-13

IMPORTANT INFORMATION FOLLOW ALL INSTRUCTIONS

1.0 General Information

These installation instructions contain important information about the proper installation of OPW-FCS's FlexWorks Flexible Piping Systems.This information and instructions primarily deal with underground fuel piping. Other components such as tank sumps, dispenser sumps, and other piping systems used for tank vent, stage II vapor recovery and remote fill lines have their own individual installation instructions. Refer to OPW-FCS's FlexWorks Flexible Piping Manual for more detailed instructions.

This installation instruction or the information contained within, must be given to the site owner or operator upon completion of work.

NOTICE: OPW-FCS system components may only be installed and serviced by a factory trained and currently certified installer in order for the product warranty to be valid. The use of non-certified personnel or any deviations from these written procedures could result in damage or leakage of the system and void the product warranty. Contact OPW-FCS's Customer Service Department for more information at 1-800-422-2525.

2.0 UL Listings

FlexWorks double wall piping is listed with Underwriter's Laboratories (UL®) under file #MH16678 and labeled as follows: Motor Vehicle Fuels, High Blend Fuels, Concentrated Fuels and Aviation and Marine.

3.0 UL Listed Warranted Fuels

Below are the listed fuels that have been tested under UL 971 and are warranted for use with the FlexWorks Flexible Piping System.

Motor Vehicle Fuels

100% ASTM Reference Fuel No. 2

100% ASTM Reference Fuel C

85% Reference Fuel C – 15% MTBE

70% Reference Fuel C – 30% Ethanol

85% Reference Fuel C – 15% Methanol

High Blend Fuels

50% Reference Fuel C - 50% Methanol

50% Reference Fuel C - 50% Ethanol

Concentrated Fuels

100% Methanol

100% Ehtanol

100% Toluene

Aviation and Marine Fuels

100% Premium Leaded Gas

100% Kerosene

WARNING: Failure to secure written approval from OPW-FCS concerning non-warranted fuels and liquid chemicals, will void the product warranty and could potentially cause environmental damage or personal injury.

FlexWorks Pipe Couplings (DPC Series)						
Sizes	**Couplings**	**Male Adaptors**	**Female Adaptors**	**Tee Fittings**	**Elbow Fitting**	**Connectors**
1.5" FlexWorks (C15A)	DPC-2150A	SMA-1515, SMA-1520		STF-1515	SEF-1515	SCC-1515
2" FlexWorks (C20A)	DPC-2200A	SMA-2020		STF-2020, SRT-2215, SRT-2151	SEF-2020, SRE-2015	SCC-2020
FlexWorks Pipe Couplings (SPC Series)						
Sizes	**Couplings**	**Male Adaptors**	**Female Adaptors**	**Tee Fittings**	**Elbow Fitting**	**Connectors**
3/4" FlexWorks (C075A)	SPC-0075	SMA-7575	SFA-7575			
1" FlexWorks (C10A)	SPC-0100	SMA-1010	SFA-1010			
1.5" FlexWorks (C15A)	SPC-0150A	SMA-1515, SMA-1520		STF-1515	SEF-1515	SCC-1515
2" FlexWorks (C20A)	SPC-0200A	SMA-2020		STF-2020, SRT-2215, SRT-2151	SEF-2020, SRE-2015	SCC-2020
3" FlexWorks (C30A)	SPC-0300	SMA-3030		STF-3030	SEF-3030	SCC-3030

4.0 Piping Applications

FlexWorks flexible piping may be used in the following applications.

- Pressure System Supply Piping
- Suction System Supply Piping
- Tank Vent Piping
- Stage II Vapor Recovery Piping
- Remote Fill Lines

WARNING: FlexWorks piping is not warranted for above ground transmission of flammable liquids due to the possible exposure to fire.

5.0 Operating Pressures & Vacuums

FlexWorks piping and its associated fitting systems have a minimum five to one (5:1) safety factor from maximum rated operating pressure for the primary pipe. The product fluids transferred should not exceed the maximum operating pressures indicated on each pipe size. For suction systems the pipe is capable of withstanding 29" mercury vacuum.

6.0 Operating Temperatures

FlexWorks pipe is for underground use only and a maximum operating temperature of 125ºF (52ºC).

7.0 Allowable Bend Radius

FlexWorks piping is a semi-flexible pipe and should never be bent at a radius of less than the designed bend radius. If a section of pipe becomes kinked, the kinked section should be cut-out of a piping length and it should be discarded and never used. **NOTICE: For cold weather conditions (below freezing) refer to the Flexible Piping Manual for important installation tips.**

Pipe Diameter	Min Bend Radius
3/4", 1"	18"
1-1/2"	24"
2"	36"
3"	72"

8.0 Storage, Transit & Handling

OPW-FCS requires that all piping, fittings and system components be stored in such a manner that they will not be subject to direct sunlight and /or excessive environmental conditions. OPW-FCS requires that the piping, fittings and system components are handled in such a manner that it will not cause any unnecessary damage. Do not drop, cut or cause severe impact to any of the components. Keep all piping, fittings and other components in the original packaging until ready for use. Keep all coupling protector caps/ covers on couplings and fittings until assembly. Inspect all fittings prior to installing. Parts that have been cut, cracked or otherwise misused should be replaced. Do not drive over, drag or damage FlexWorks Piping. Any damaged or compromised section of pipe should be discarded and not be used.

NOTICE: Never use knives or razor blades to open packaging as damage to piping could occur.

9.0 Assembly of FlexWorks Piping System

FlexWorks piping must be installed with OPW-FCS tools and fittings. These include an OPW-FCS coupling machine fitted with the appropriate size swage kit, bull nose plugs, a pipe cutter tool and jacket cutter/swivel wrenches for the appropriate size pipe. Failure to use OPW-FCS tools and fittings may cause damage or failure of the system and void product warranty.

9.1 Pipe Burial Requirements

FlexWorks piping, and Access piping are strong, yet flexible, piping systems and must be buried in such a manner so that they will not compress. Be sure that proper pipe trenching, backfill materials and burial depth requirements are followed and in place prior to measuring and cutting FlexWorks piping and Access piping. Refer to the Flexible Piping Manual for complete instructions and warranty compliance.

Note: FlexWorks piping is intended for installation in normal soil applications.

CAUTION: Use extra caution when backfilling piping in trenches or open excavations so as not to damage or crush the piping or any associated fittings. Avoid sudden impacts from dumping backfill materials. Spread backfill gradually and evenly. Failure to do so could cause immediate or long-term damage to the piping.

CAUTION: FlexWorks and Access piping can be punctured by grade stakes or other sharp objects driven into the ground. The use of tracer tape or a schematic of the underground piping should always be kept onsite and marked off prior to commencing any work that may damage the pipe.

NOTICE: Installation instructions for containment sumps are not contained within this FlexWorks Piping instructions. Refer to the dedicated product manuals for the correct installation procedures and techniques for the containment sumps and flexible entry boots.

9.2 Installing Pipe Adapters

All FlexWorks fittings have proprietary threads and cannot be directly connected to standard National Pipe Thread (NPT) pipe fittings without an OPW-FCS adapter. After all plumbing assemblies have been fabricated and installed inside the tank and dispenser sumps, install the appropriate OPW-FCS pipe adapter (Swivel Adapter or Fitting) into NPT threaded pipefitting. This is done with standard pipefitting tools, but caution should be taken not to damage the OPW-FCS threads or O-ring surfaces.

NOTICE: For NPT threads, use only UL classified thread sealant specifically formulated for gasoline and petroleum products. Do not over-tighten fittings for it could cause damage to the tapered threads.

CAUTION: Cutting the steel riser pipes and plumbing assemblies too long or too short could cause significant stress on the FlexWorks pipe and coupling that could ultimately cause failure. The FlexWorks fittings should always be in direct alignment with the flexible entry boot openings and cannot be used in lieu of a flex connector.

NOTE: It is important to select the correct size and type pipe entry boot to be used for a specific application and pipe size. Refer to the OPW-FCS Flexible Entry Boot Manual of detailed information for installing these entry seals.

9.3 Installing Access Piping

Access Piping is a large diameter corrugated flexible piping that adds additional protection to FlexWorks piping and allows the pipe to be removed and replaced without the need for excavation. Measuring and cutting Access Pipe should be done prior to measuring

and installation of FlexWorks piping. The installation of Access Pipe is highly recommended for all FlexWorks piping systems. Refer to the Access Pipe installation manual for complete instructions and warranty compliance.

9.4 Measuring Pipe Distances: When measuring the distance between containment sumps to determine the proper length of a flexible pipe section to be installed, it is important to consider that the pipe is flexible and will not be installed perfectly straight. A slight weaving of the pipe in the piping trench is recommended to compensate for expansion and contraction characteristics of the piping. Measurements must be taken through the Duct chase pipe to insure the proper length. The measuring points will be from the face of the OPW-FCS fitting to the next OPW-FCS fitting. Record the "measured distance" and make the following adjustments depending on the connection system used: After the adjustments have been made to the recorded "measured distance", measure the outside of the unrolled flexible pipe carefully, following the bends in the piping and mark the location to be cut with a permanent marker. Cut the pipe with an OPW-FCS pipe cutter as described in the Flexible Piping Manual.

NOTICE: Be sure the pipe cutter is sharp and free of chips for a proper cut. Inspect the end of the cut to be sure the construction of the pipe was not damaged or compromised.

Type Couplings	Pipe Diameter	Length Adjustment
Swivel (SPC and DPC	1-1/2" and 2"	Subtract 1"

9.5 Coupling FlexWorks Piping

STOP: Before coupling FlexWorks Piping, some components such as entry boots and the Duct may need to be installed onto the pipe prior to coupling. Refer to the Flexible Piping Manual for further clarification.

The FlexWorks piping system requires the use of the OPW-FCS Coupling Machine for proper installation of the pipe couplings onto the ends of the flexible pipe sections. Refer to the Flexible Piping Manual for proper coupling machine use and warranty compliance. Different sizes of Swivel Couplings require their own swage kit to properly swage the coupling onto the pipe. Refer to the OPW-FCS Products Price List for a list of the appropriate swage kit.

WARNING: OPW-FCS's coupling machine is not intrinsically safe and cannot be used in hazardous areas.

NOTICE: Do not use silicone-based lubricants to lubricate the swage. Only metal assembly paste or white lithium grease should be applied into the coupling insert. Make sure entire coupling assembly is on the machine prior to swaging.

NOTICE: Make sure that the pipe is in a vertical position an that the coupling ferrule is against the coupling nut and the swivel nut is flush against the faceplate at all times during the swaging cycle.

9.6 Coupling Inspection: Inspect the installed pipe coupling assembly inside and out to make sure there was no damage to the insert, ferrule or nut during the swaging operation.

NOTICE: Before and after the coupling process the protective coupling cover should be kept on the coupling. This precaution will lessen the possibility of damage and contamination by dirt, sand and debris that could compromise the sealing process.

9.7 Installing Coupled Pipe Sections

After a pipe section has been coupled and inspected, the coupled pipe section may be connected to the OPW-FCS adapters and/ or fittings.

9.8 Installing Pipe Through Chase: At this stage all of the Access chase piping sections should already be installed. Install the appropriate size Bull Nose Plug into the coupling and push the FlexWorks piping through the Duct. (Refer to OPW-FCS's Flexible Underground Piping Manual for complete instructions)

9.9 Connecting Pipe Sections

After all coupled pipe sections have been inserted into the containment sumps then connection of the pipe sections can begin inside the containment sumps. Prior to connecting all double wall FlexWorks piping with swivel couplings, install the appropriate size test boot.

NOTICE: Prior to connecting Swivel Couplings, inspect the pipe couplings to make sure all seals are in place and free of dirt and debris. Look for any damage to the seals that may have occurred during the coupling procedure or when installing through the Access Pipe.

9.9.1 Swivel Fitting Systems: When installing swivel couplings, hand tighten the coupling onto the OPW-FCS fittings until it is snug. With an OPW-FCS swivel wrench, tighten the coupling nut ¼ turn more or to 200 in/lbs. Do not allow the pipe to rotate while tightening. The ¼ turn procedure will prevent over tightening of the coupling past the maximum 200 in/lbs.

CAUTION: Over tightening of the coupling will cause damage to the coupling gasket and result in the eventual leak of the system.

CAUTION: Never use pipe dope or sealant on the threads of a Swivel Coupling.

9.9.2 ¾" and 1" Swivel Pipe Couplings: The ¾" and 1" FlexWorks pipe couplings are fixed male NPT fittings and are assembled as rigid steel pipe. After installing the appropriate test boot, apply a liberal amount of UL Listed thread sealant to the threads of the coupling and tighten to 20 ft/lbs.

9.9.3 Interstitial Test and Connector Tube Assemblies

The jacket of double wall FlexWorks piping must be tested to ensure liquid tightness. Connect all test and connector tubes into the test boots. Tighten all band clamps to 30 in/lbs.

10.0 Testing Supply Pipe

It is important to properly test the FlexWorks piping system prior to backfill to insure there are no leaks in the primary or secondary piping. The following test procedures are provided as a guideline only and the manufacturer assumes no responsibility or liability for the consequences of any testing practices.

Note: Access piping provides additional protection and the ability to perform routine maintenance or removal of FlexWorks piping and is not intended as containment. Air testing of the Access piping is not required however, should testing of the chase be desired, pressurize the Access Pipe to no more than 5 PSI.

CAUTION: Integrity testing with air, gas or water can be dangerous and it is very important that the proper testing equipment be used and that the testing procedures be adhered to. OPW-FCS assumes no responsibility or liability for the consequences of any testing practices. Only qualified and experienced personnel should conduct the air pressure testing. Never disconnect couplings, caps, or plugs unless the air pressure has been released.

NOTICE: All testing requirements must be in accordance with all applicable codes.

CAUTION: Always make sure the underground storage tank and dispensers are isolated from the piping system when conducting pressure tests.

NOTICE: Significant temperature changes can result in a pressure reading differential.

10.1 Primary Pressure Testing

- **Pre Backfill Pressure Testing:** Before backfilling of the pipe, an air pressure hold & soap test is required. Pressurize the primary pipe to sixty pounds per square inch (60 PSI). Gradually apply air pressure into the flexible piping line and maintain this pressure for a minimum of 1 hour, or in accordance with the authority having jurisdiction (AHJ), prior to backfilling.
- **Post Backfill Air Pressure Testing:** After backfilling, if the pressure on the primary was released, an additional air pressure hold test is required. Pressurize the primary pipe to sixty pounds per square inch (60 PSI). Gradually apply air pressure into the flexible piping line and maintain this pressure for a minimum of 1 hour, or in accordance with the authority having jurisdiction (AHJ), making sure that there is no drop in pressure.

10.2 Secondary Pressure Testing

- **Pre Backfill Air Pressure Testing:** After the primary line pressure stabilizes, gradually apply air pressure into the interstitial space of the flexible piping line. Do not exceed ten pounds per square inch (10psi) or 69kPa, making sure there is no drop in pressure for a minimum of one hour, or in accordance with the authority having jurisdiction (AHJ).
- **Post Backfill Air Pressure Testing:** After backfilling an air pressure hold test is required. After the primary has held pressure steadily for at least 1 hour, gradually apply air pressure to the secondary test tube, not to exceed 10 PSI. Maintain this pressure for a minimum of 1 hour, or in accordance with the authority having jurisdiction (AHJ), making sure that there is no drop or increase in pressure.

NOTICE: During pressurizing, check the reading on the interstitial test gauge that should be securely connected to the Interstitial Test Tube. Any increase in pressure will indicate a leak in the primary pipe or Fittings.

NOTICE: All testing requirements must be in accordance with all applicable codes.

CAUTION: Always make sure the underground storage tank and dispensers are isolated from the piping system when conducting pipe pressure tests.

11.0 Routine Maintenance and Visual Inspections

OPW-FCS recommends routine (at least once a month) visual inspections inside all containment sumps. Fuel leaks collected in containment sumps must be reported immediately and investigated by the site owner. If leakage or damage to the piping system is suspected, OPW-FCS must be notified immediately.

All sumps must be kept free of fuel, water and debris. When changing fuel filters at the dispenser, make sure any spilled product is cleaned out of the bottom of the dispenser sump to prevent a possible fire hazard.

CAUTION: Ignoring or disabling leak detection alarms can lead to further damage and possible failure of the system.

CAUTION: Failure to remove fuel and liquids from containment sumps may compromise the performance and integrity of the sump and its associated fittings and seals over prolonged periods of time.

12.0 Warranty Registration

Warranty registration must be completed and mailed to OPW-FCS for warranty activation. A copy of the warranty registration should be given to the site owner for their records.

13.0 OPW-FCS Contact

OPW-FCS can be contacted if there are any questions concerning the installation, maintenance or repair of FlexWorks piping. Additional publications are also available on OPW-FCS's website www.opwglobal.com or upon request.

OPW®
FUELING CONTAINMENT SYSTEMS

3250 US 70 Business West
Smithfield, N.C., 27577-0330
Customer Service:1-(800) 422-2525
Technical Service and Questions: 1-(877) OPW-TECH
www.opwglobal.com

Notice: OPW-FCS products must be used in compliance with applicable federal, state, provincial and local laws and regulations. Product selection should be based on physical specifications and limitations and compatibility with the environment and material to be handled. OPW-FCS makes no warranty of fitness for a particular use. All illustrations and specifications in this literature are based on the latest production information available at the time of publication. Prices, materials and specifications are subject to change at any time, and models may be discontinued at any time, in either case, without notice or obligation. For complete OPW-FCS warranty information, visit our web site at www.opwglobal.com.

APPENDIX C-2

PIPING SECONDARY CONTAINMENT INTEGRITY TESTING

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the integrity of the interstitial space of double-walled piping. See PEI/RP1200 Section 5 for the test procedure.						
Tank Number						
Piping Run						
Piping Material						
Product Stored						
Test Start Time						
Initial Test Pressure, psig (Test procedure specifies 5 psig.)						
Test End Time						
Final Test Pressure, psig						
Pressure Change (No reduction in pressure allowed for pass.)						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-3

SPILL BUCKET INTEGRITY TESTING HYDROSTATIC TEST METHOD SINGLE- AND DOUBLE-WALLED VACUUM TEST METHOD

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the leak integrity of single- and double-walled spill buckets. See PEI/RP1200 Section 6.2 for hydrostatic test method, Section 6.3 for single-walled vacuum test method and Section 6.4 for double-walled vacuum test method.						
Tank Number						
Product Stored						
Spill Bucket Capacity						
Manufacturer						
Construction	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled
Test Type	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled
Spill Bucket Type	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor
Liquid and debris removed from spill bucket?*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Visual Inspection (No cracks, loose parts or separation of the bucket from the fill pipe.)	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Tank riser cap included in test?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Drain valve included in test?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Starting Level						
Test Start Time						
Ending Level						
Test End Time						
Test Period						
Level Change						
Pass/fail criteria: Must pass visual inspection. Hydrostatic: Water level drop of less than 1/8 inch; Vacuum single-walled only: Maintain at least 26 inches water column; Vacuum double-walled: maintain at least 12 inches water column.						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

*All liquids and debris must be disposed of properly.

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-4

CONTAINMENT SUMP INTEGRITY TESTING HYDROSTATIC TESTING METHOD

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the leak integrity of containment sumps. See PEI/RP1200 Section 6.5 for the test method.						
Containment Sump ID						
Containment Sump Material						
Liquid and debris removed from sump?*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Visual Inspection (No cracks, loose parts or separation of the containment sump.)	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Containment Sump Depth						
Height From Bottom to Top of Highest Penetration						
Starting Water Level						
Test Start Time						
Ending Water Level						
Test End Time						
Test Period (Minimum test time: 1 hour)						
Water Level Change						
Pass/fail criteria: Must pass visual inspection. Water level drop of less than 1/8 inch.						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

*All liquids and debris must be disposed of properly.

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-6

OVERFILL ALARM OPERATION INSPECTION

Facility Name:		Owner:		
Address:		Address:		
City, State, Zip Code:		City, State, Zip Code:		
Facility I.D. #:		Phone #:		
Testing Company:		Phone #:	Date:	

This procedure is to determine whether the high level alarm is operational and will trigger when the tank is no more than 90% full. See PEI/RP1200 Section 7.3 for the inspection procedure. This procedure is applicable to tank level monitor stems that touch the bottom of the tank when in place.

Tank Number				
Product Stored				
Tank Level Monitor Brand and Model				
1. Tank Volume, gallons				
2. Tank Diameter, inches				
3. Overfill alarm activates in the test mode at the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
4. When activated, overfill alarm can be heard or seen while delivering to the tank?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
5. After removing the probe from the tank, it has been inspected and any damaged or missing parts replaced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6. Float moves freely on the stem without binding?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
7. Moving product level float up the stem trigger alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
8. Inch level from bottom of stem when 90% alarm is triggered.				
9. Tank volume at inch level in Line 8.				
10. Calculate (Line 9 / Line 1) x 100				
11. Is Line 10 less than 90%?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
12. Fuel float level on the console agrees with the gauge stick reading?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes No
13. Overfill alarm activates at any product level above 90% tank capacity?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If any answers in Lines 3, 4, 5, 6, 7 or 11 are “No,” or Line 13 is “Yes,” the system has failed the test.				
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:				

Tester’s Name (print)_____ Tester’s Signature _____

APPENDIX C-7

AUTOMATIC TANK GAUGE OPERATION INSPECTION

Facility Name:		Owner:		
Address:		Address:		
City, State, Zip Code:		City, State, Zip Code:		
Facility I.D. #:		Phone #:		
Testing Company:		Phone #:	Date:	

This procedure is to determine whether the automatic tank guage (ATG) is operating properly. See PEI/RP1200 Section 8.2 for the inspection procedure. This procedure is applicable to tank level monitor stems that touch the bottom of the tank when in place.

Tank Number				
Product Stored				
ATG Brand and Model				
1. Tank Volume, gallons				
2. Tank Diameter, inches				
3. After removing the ATG from the tank, it has been inspected and any damaged or missing parts replaced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
4. Float moves freely on the stem without binding?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
5. Fuel float level agrees with the value programmed into the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6. Water float level agrees with the value programmed into the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
7. Inch level from bottom of stem when 90% alarm is triggered.				
8. Inch level at which the overfill alarm activates corresponds with value programmed in the gauge?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
9. Inch level from the bottom when the water float first triggers an alarm.				
10. Inch level at which the water float alarm activates corresponds with value programmed in the gauge?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

If any answers in Lines 3, 4, 5, or 6 are “No,” the system has failed the test.

Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail

Comments:

Tester’s Name (print)_____ Tester’s Signature _____

LIQUID SENSOR FUNCTIONALITY TESTING

Facility Name:				Owner:			
Address:				Address:			
City, State, Zip Code:				City, State, Zip Code:			
Facility I.D. #:				Phone #:			
Testing Company:				Phone #:		Date:	
This procedure is to determine whether liquid sensors located in the interstitial space of UST systems are able to detect the presence of water and fuel. See PEI/RP1200 Section 8.3 for the test procedure.							
Sensor Location							
Product Stored							
Type of Sensor	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating
Test Liquid	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product
Is the ATG console clear of any active or recurring warnings or alarms regarding the leak sensor? If the sensor is in alarm and functioning, indicate why.	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Is the sensor alarm circuit operational?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Has sensor been inspected and in good operating condition?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
When placed in the test liquid, does the sensor trigger an alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
When an alarm is triggered, is the sensor properly identified on the ATG console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Any “No” answers indicates the sensor fails the test.							
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:							

Tester’s Name (print)_____ Tester’s Signature _____

APPENDIX C-9

MECHANICAL AND ELECTRONIC LINE LEAK DETECTORS PERFORMANCE TESTS

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This data sheet can be used to test mechanical line leak detectors (MLLD) and electronic line leak detectors (ELLD) with submersible turbine pump (STP) systems. See PEI/RP1200 Sections 9.1 and 9.2 for test procedures.						
Line Number						
Product Stored						
Leak Detector Manufacturer						
Leak Detector Model						
Type of Leak Detector	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD
MLLD (ALL PRESSURE MEASUREMENTS ARE MADE IN PSIG)						
STP Full Operating Pressure						
Check Valve Holding Pressure						
Line Resiliency (ml) (line bleed back volume as measured from check valve holding pressure to 0 psig)						
Step Through Time in Seconds (time the MLLD hesitates at metering pressure before going to full operating pressure as measured from 0 psig with no leak induced on the line)						
Metering Pressure (STP pressure when simulated leak rate 3 gph at 10 psig)						
Opening Time in Seconds (the time the MLLD opens to allow full pressure after simulated leak is stopped)						
Does the STP pressure remain at or below the metering pressure for at least 60 seconds when the simulated leak is induced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Does the leak detector reset (trip) when the line pressure is bled off to zero psig?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Does the STP properly cycle on/off under normal fuel system operation conditions?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
A "No" answer to either of the above questions indicates the MLLD fails the test.						
ELLD (ALL PRESSURE MEASUREMENTS ARE MADE IN PSIG)						
STP Full Operating Pressure						
How many test cycles are observed before alarm/shutdown occurs?						
Does the simulated leak cause an alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
A "No" answer to the above question indicates the ELLD fails the test.						
Does the simulated leak cause an STP shutdown?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

Tester's Name (print)_____ Tester's Signature _____

AUTOMATIC TANK GAUGE SETUP STANDARDS

MAVERIK VEEDER-ROOT TLS 450-PLUS SETUP FOR NEW CONSTRUCTION (THROUGH WORKFLOW WIZARD *NON-CALIFORNIA SITES*)

LIST OF MENU OPTIONS			DEFINED VALUES
Menu>Setup>Workflow>Setup Workflow			
	Setup Display>Language/Units		
		System Language	English
		System Units	US
	Setup>Date and Time		
		Current Date	site specific
		Current Time	site specific
		Time Zone	site specific (local time zone)
		NTP	ENABLED
		NTP Server	oldfaithful.maverik.com
		Status	*Read-only field*
		Time Synchronization	
			Stratum	*Read-only field*
			Server	*Read-only field*
			Offset	*Read-only field*
			Refresh	*Read-only field*
	Setup>Display>Date/Time Format		
		Date Format	MON DD YYYY
		Date Separator	/
		Time Format	HH:MM:SS
	Setup>Display>Number Format		
		Decimal Separator	period
		Thousands Separator	comma
	Setup>Headers		
		Header 1	FMS ID number, Store number
		Header 2	Store street address
		Header 3	Store City, State, ZIP
		Header 4	Store Phone Number
		Fax Sender Name	*no entry*
		Fax Phone Number	*no entry*

Setup>System>Alarm Filtering		
	Alarm Filtering	DISABLED
Setup>Communication>System Hostname		
	System Hostname	VR-### (where ### is the store number)
Setup>Communication>Ethernet Port		
	Eth 1 ***Port typically used by Maverik. Front port (furthest from the wall).***	
	IP Address Type (IP Assignment)	STATIC (DEFAULT)
	IP Address	site specific (can be obtained from Site Attributes)
	IP Subnet Mask	255.255.255.128
	IP Gateway Address	site specific (can be obtained from Site Attributes)
	IP Default Gateway	ENABLED
	Primary DNS	10.7.39.14
	Secondary DNS	10.7.39.15
	MAC Address	*Read-only field*
	Serial Command Port	10### (where ### is the store number)
	SSH Port	22 (DEFAULT)
	Serial SSH	DISABLED
	HTTPS port	443 (DEFAULT)
	Sender Email Address	*no entry*
	Serial Command Security	DISABLED
	Security Code	*no entry*
	ETX Characters Display	(DEFAULT)
	ETX Characters Computer	(DEFAULT)
	Eth 2 Port typically used by on-site techs. Not used by Maverik. Rear port (closest to the wall).	
Setup>Communication>Internal Modem (NOT SPECIFIED AT MAVERIK SITES)		
Setup>Communication>CDIM Port (NOT SPECIFIED AT MAVERIK SITES)		
Setup>Communication>TDIM Port *(Use if directed by Maverik IT when BIR is to be used with Allied Controller)*		
	Configured	after Allied updated software
	Label	VR BIR
	Port Number	35555
	Protocol	VRProtocolDIM
	Units Reported	US
Setup>Communication>IFSF (NOT SPECIFIED AT MAVERIK SITES)		
Setup>Communication>Serial Port *(If RS232 Card set as EDIM for BIR functionality - used for Allied Interface)*		

Configured	ENABLED		
Label	Allied EDIM		
Usage	EDIM		
Protocol (only visible if EDIM is selected for Usage)	VRProtocolDIM		
Units Reported	US		
Baud Rate	*auto populates*		
Data Bits	*auto populates*		
Parity	*auto populates*		
Stop Bits	*auto populates*		
Handshaking	*auto populates*		
Comm Port Security Enabled	DISABLED		
Security Code	*no entry*		
RS232 End of Message	DISABLED		
Setup>Communication>SMTP Relay *Should not be setup.*			
Setup>Devices			
Probe Setup			
Configured	ENABLED		
Address	site specific		
Label	Matching label for product		
FOLLOW THESE LABELING STANDARDS	UNL GASOLINE	1, 2, 3 etc. for multiple tanks	
	PREM GASOLINE		
IMPORTANT! Follow probe numbering assignments for tanks ***exactly*** as shown on Fuels Sketch supplied by Maverik	DIESEL #2	1, 2, 3 etc. for multiple tanks	
	ETHANOL-FREE GAS		
	ECO UNL GAS (E15)		
	DEF		
	BIODIESEL B100		
	BIODIESEL B99		
Serial Number (Read Only Field)	*Read-only field*		
Type (Read Only Field)	*Read-only field*		
Float Type	product specific: 4.0" phase separation for Unleaded and Premium, 4.0" for all other products		
Relay Setup			
Configured	ENABLED		
Address	site specific		
Label	site specific		
Relay Type	site specific		

Relay Orientation			site specific	
External Input Setup				
Configured			ENABLED	
Address			site specific	
Label			site specific	
Type			site specific	
Orientation			site specific	
Temperature Sensor Setup (DEF recirculation-NOT SPECIFIED AT MAVERIK SITES)				
Liquid Sensor Setup				
Configured			ENABLED	
Address			site specific	
Label	STP Sump: use (FULL TANK LABEL) + "STP"		example: UNL GASOLINE STP, PREM GASOLINE STP, DIESEL STP, etc.	
	Intertstitial: use (FULL TANK LABEL) + "INT"		example: UNL GASOLINE INT, PREM GASOLINE INT, etc.	
	Interstitial multi-compartment tanks: use (abbreviation/abbreviation) + "INT"		example: UNL/PREM/DSL INT, DEF/ETH/E-FREE INT, BIO/B99/E15 INT, etc.	
	Dispenser Sump: use (NUMBER) + UDC		example: 1/2 UDC, 3/4 UDC, 5/6 UDC, etc.	
Model	STP Sensor		Tri-State (Single Float)	Model 794380-208
	Dry Interstice		Tri-State (Single Float)	Consult with Maverik for the specificiation, if needed.
	Brine Interstice		Dual Point Hydrostatic	Model 794380-301
	UDC Sensor		Tri-State (Single Float)	Model 794380-208
Category			sensor location specific	
Type A Sensor (2-Wire CL) Setup (NOT SPECIFIED AT MAVERIK SITES)				
Mag Sensor Setup (NOT SPECIFIED AT MAVERIK SITES)				
Groundwater Sensor Setup (NOT SPECIFIED AT MAVERIK SITES)				
Vapor Sensor Setup (CALIFORNIA SITES ONLY)				
Line Pressure Sensor Setup				
Configured			ENABLED	
Address			site specific	
Label				
	FOLLOW THESE LABELING STANDARDS		UNL GASOLINE	1, 2, 3 etc. for multiple lines/PLLDs
			PREM GASOLINE	
			DIESEL #2	1, 2, 3 etc. for multiple lines/PLLDs

	ETHANOL-FREE GAS
	ECO UNL GAS (E15)
	DEF
	BIODIESEL B100
	BIODIESEL B99
Serial Number	*auto populates*
ATM Pressure Sensor Setup (CALIFORNIA SITES ONLY)	
Vapor Pressure Sensor Setup (CALIFORNIA SITES ONLY)	
LVDIM/MDIM Setup (CALIFORNIA SITES ONLY)	
Setup>Vapor Monitor>General (CALIFORNIA SITES ONLY)	
Setup>Vapor Monitor>Collection Monitor (CALIFORNIA SITES ONLY)	
Setup>Vapor Collection>VMC Configuration (CALIFORNIA SITES ONLY)	
Setup>BIR>General	
Product Threshold Alarm	ENABLED
Daily Close Time	2:00:00 AM (DEFAULT)
Week Close Time	Sunday
Alarm Threshold Delivery Type	STANDARD
Temperature Compensation	STANDARD
Meter Calibration Offset %	0.00 (DEFAULT)
BIR Status Warning Enable	DISABLED
BIR Daily Close Warning Enable	DISABLED
BIR Shift Close Warning Enable	DISABLED
Setup>BIR>Threshold Alarm	
Test Type	Monthly
Rolling Days	31
Throughput	ENABLED
%	1
Volume Offset	130
Capacity	*no entry*
%	*no entry*
Volume Offset	*no entry*
Deliveries	*no entry*
%	*no entry*
Volume Offset	*no entry*
Fixed Values	*no entry*
Value	*no entry*
Setup>Tank>General	

Configured	ENABLED	
Label		
FOLLOW THESE LABELING STANDARDS	UNL GASOLINE	1, 2, 3 etc. for multiple tanks per product
	PREM GASOLINE	
IMPORTANT! Follow probe numbering assignments for tanks ***exactly*** as shown on Fuels Sketch supplied by Maverik	DIESEL #2	1, 2, 3 etc. for multiple tanks per product
	ETHANOL-FREE GAS	
	ECO UNL GAS (E15)	
	DEF	
	BIODIESEL B100	
Product Code		
	01	UNLEADED
	03	PREMIUM
	04	TRUCK DIESEL
	07	ETHANOL-FREE
	09	AUTO DIESEL
	E15	ECO UNL (E15)
	DEF	DEF
	(TBD)	BIODIESEL
	(TBD)	B99
	(TBD)	B100
	(TBD)	B20
Product Color	*UNDEFINED*	
Probe	Probe number should match Tank number	
Probe Offset	Tank specific based on field measurements	
Full Volume (Capacity)	Actual max volume ***per manufacturer's tank chart***	
Diameter	Highest dipstick reading ***on manufacturer's tank chart***	
Tank Tilt	Tank specific based on field measurements	
Thermal Coefficient	Gas: 0.00070	Diesel: 0.00045
	DEF: 0.00040	E-15: 0.000692
Meter Data Present	ENABLED	

Pump Threshold %	10%	
Stick Height Offset	site/probe/tank-specific	
Delivery Delay	3 min	
Gross Test Fail	ENABLED	
Periodic Test Fail	ENABLED	
Annual Test Fail	DISABLED	
GOST Volume Correction	not used in U.S.	
Setup>Tank>Limits		
Max. Volume (Label Vol)	Actual max volume per mfr. tank chart	
High Product (% of Max Vol.)	95%	
Delivery Overfill (% of Max. Volume)	90%	
Delivery Limit (% of Full Volume)	3%	
Low Product	***Volume associated with 10" level per MANUFACTURER tank chart.***	
High Water Warning	1"	UNL GASOLINE
	1"	PREM GASOLINE
	2"	DIESEL #2
	2"	ETHANOL-FREE GAS
	1"	ECO UNL (E15)
	n/a	DEF
	0.1"	BIODIESEL
	0.1"	B99
	0.1"	B100
High Water Alarm	1.5"	UNL GASOLINE
	1.5"	PREM GASOLINE
	3"	DIESEL #2
	3"	ETHANOL-FREE GAS
	1.5"	ECO UNL (E15)
	n/a	DEF
	0.1"	BIODIESEL
	0.1"	B99
	0.1"	B100
Water Alarm Filter Level	Low (DEFAULT)	
Water Alarm Filter Delay	180 seconds (DEFAULT)	
Leak Alarm Limit	n/a: SLD tests only	
Sudden Loss Limit	99 gallons (DEFAULT)	

Density Low Limit	0.000
Density High Limit	0.000
Fuel Low Temperature Limit	58 degrees F (DEFAULT)
Fuel High Temperature Limit	140 degrees F (DEFAULT)
Setup>Tank>Environmental Test	
SLD **(NOT SPECIFIED AT MAVERIK SITES)**	
CSLD **(NOT SPECIFIED AT MAVERIK SITES USING INTERSTITIAL MONITORING)**	
Setup>Tank>Profile	
Tank Profile	Four Point ***(PLEASE USE MANUFACTURER TANK CHART. Please DO NOT PROGRAM FROM MEMORY.)***
Full Volume	*Read-only field*
End Shape	*tank specific-(only when using One Point)*
Setup>Tank Chart>Charts	
#	tank specific
Name	tank specific
Type	Four Point
Source	User-Entered
Setup>Tank>HRM Limits (International Option) (NOT SPECIFIED AT MAVERIK SITES)	
Setup>Tank>Siphon Sets	
Available Tanks	site specific
Siphon Set	site specific
Setup>Tank>All Tanks	
Ullage Display Mode	User Ullage
Full Ullage Label	100% Ullage
User Ullage%	90
Print TC Volumes	ENABLED
TC Reference	60 Degrees
CSLD Evaporation Reid Vapor Pressure Chart	n/a
Periodic Test Needed Warnings	DISABLED
Annual Test Needed Warnings	DISABLED
TC Density	DISABLED
Stick Height	DISABLED
Leak Test Report Format	Standard (DEFAULT)
Leak Test Region	EPA (DEFAULT)
Setup>Vapor Monitor>Pressure Zones (CALIFORNIA SITES ONLY)	

Setup>Tank>Timed Sudden Loss		
	Schedule Type	*no entry*
Setup>Products>Labels		
	Product #	site specific
	Product Label	site specific
Setup>Product>Product Mapping		
	Tank(s)	site specific
	Product	site specific
Setup>Tank Chart>AccuChart		
	Update Schedule	Immediate
	Apply Date 1	*UNDEFINED*
	Apply Date 2	*UNDEFINED*
	Apply Date 3	*UNDEFINED*
	Apply Date 4	*UNDEFINED*
	Calibration Period	120
	Days Left to Calibration Completion	*UNDEFINED*
	Exclude Days	*UNDEFINED*
	Enable AccuChart Warnings	ENABLED
	Min Operating Level%	25%
	Max Operating Level%	75%
Setup>Pumps and Lines>Pump Controller *IPC*		
	Configure	site specific
	Label	site specific
	Address	site specific
Setup>Pumps and Lines>Pumps		
	Configured	ENABLED
	Pump Label	use (tank label) followed by PUMP
	Mode	TLS Pump Control
	Tank	tank-specific
	Pump Control	R1 (tank 1 label), R2 (tank 2 label), etc.
	Pump Sense	ExtInp 1: (tank 1 label), ExtInp 2: (tank 2 label), etc.
	Line	*Read-only field*
	Pump Relay Monitor Device	** Pump Relay Monitor can be used to detect a stuck relay. Consult Maverik (See Manual 576014-XXX).*

Stuck Relay	default is 60 seconds	
Max Run Time	*no entry*	
Setup>Pumps and Lines>Line		
Configured	ENABLED	
Label		
FOLLOW THESE LABELING STANDARDS	UNL GASOLINE	1, 2, 3 etc. for multiple lines per product
	PREM GASOLINE	
	DIESEL #2	1, 2, 3 etc. for multiple lines per product
	ETHANOL-FREE GAS	
	ECO UNL GAS (E15)	
	DEF	
	BIODIESEL B100	
Leak Monitoring	Monitoring PLLD	
Pressure Sensor	Q1, etc.	
Line Active Relay	*no entry*	
Recirculation	None (DEFAULT)	
Manifolded	site specific	
Dispense Mode	site specific based on line manifold settings	
Active Switchover	site specific based on line manifold settings	
Switchover Volume Threshold	site specific based on line manifold settings	
Switchover Height Threshold	site specific based on line manifold settings	
In-Tank Staging ***IPC OPTION***	*no entry*	
Across-Tank Staging ***IPC OPTION***	*no entry*	
Pumps	Pm1, etc.	
Primary	site specific based on line manifold settings	
Leak Test Report Format	*Standard is default UNDEFINED*	
Setup>Pumps and Lines>PLLD		
Configured	ENABLED	
Controlling Pump	site specific	
Pipe Type	site specific	

Line Length	site specific
Line Diameter	site specific
2nd Line Length	site specific
2nd Line Diameter	site specific
1st Line Bulk Modulus	site specific
2nd Line Bulk Modulus	site specific
Thermal Coefficient	*auto populates to match assigned tank*
0.2 gph (0.76lph) Line Leak Test	DISABLED (DEFAULT)
0.1 gph (0.38lph) Line Leak Test	DISABLED (DEFAULT)
Passive 0.1 gph (0.38lph) Line Leak Test	DISABLED (DEFAULT)
Shutdown Rate	3.0 GPH (DEFAULT)
Low Pressure Shutoff	ENABLED
Low Pressure Shutoff Value	10 psi
Continuous Handle Timeout	12 hour
Fuel Out Limit	10" (DEFAULT)
Altitude Pressure Offset	n/a
Pump Comm Control Relay	*no entry*
Setup>Pumps and Lines>All Lines	
Restart on Alarm Clear	DISABLED (DEFAULT)
Line Lockout Schedule	DISABLED
Day of Week	n/a
Start Time	n/a
End Time	n/a
Setup>Pumps and Lines>All PLLD	
Line Re-Enable Method	Pass line test
Periodic Test Warnings	DISABLED
Days before Periodic Warning	n/a
Days before Periodic Alarm	n/a
Annual Test Needed Warnings	DISABLED
Days before Annual Warning	n/a
Days before Annual Alarm	n/a
Precision Test Delay (hours)	n/a
0.1 gph (0.38 lph) Line Test Auto Confirm	DISABLED
0.2 gph (0.76 lph) Line Test Auto Confirm	DISABLED
Setup>Pumps and Lines>Recirculation - [Available with Recirculation]	
Line Label	*no entry*

Configured	*no entry*
Freeze Warning Temp	*no entry*
Low Temp Recirculation	*no entry*
Low Recirculation Temp	*no entry*
High Temp Recirculation	*no entry*
High Recirculation Temp	*no entry*
Available Sensors	*no entry*
Selected Sensors	*no entry*
Setup>Temp Control - [Available with Temp Control]	
Relay Label	*no entry*
Configured	*no entry*
Operation Mode	*no entry*
Relay Control On Temp	*no entry*
Relay Control Off Temp	*no entry*
Low Temp Warning	*no entry*
Low Temperature	*no entry*
High Temp Warning	*no entry*
High Temperature	*no entry*
Available Sensors	*no entry*
Selected Sensors	*no entry*
Setup>Inventory>Report Times	
Reporting Interval	24 Hours
Storage Length	*Read-only field*
Log Start Time	12:00 AM
Setup>Inventory>Shifts	
Shift Close Method	*no entry*
Shift Close Timeout	*no entry*
Max. Number of Shift/Day	*no entry*
Shift Time 1	*no entry*
Shift Time 2	*no entry*
Shift Time 3	*no entry*
Shift Time 4	*no entry*
Shift Time 5	*no entry*
Shift Time 6	*no entry*
Shift Time 7	*no entry*
Shift Time 8	*no entry*
Setup>Delivery	

Delivery Method	Standard Automatic (DEFAULT)
Ticketed Delivery	DISABLED
TC Ticketed Delivery	TC Volume
Tank Idle Delivery	DISABLED
Setup>Automatic Events>Address Book	
Name #1	*no entry*
Email #1	*no entry*
Name #2	*no entry*
Email #2	*no entry*
Name #3	*no entry*
Email #3	*no entry*
Name #4	*no entry*
Email #4	*no entry*
Modem	
Modem # (Computer)	*no entry*
Modem COM Port	*no entry*
Modem Dial-Out String	*no entry*
Modem Number of Retries	*no entry*
Modem Retry Delay Time	*no entry*
FAX	
FAX # (Computer)	*no entry*
FAX COM Port	*no entry*
FAX Dial-Out String	*no entry*
FAX Number of Retries	*no entry*
FAX Retry Delay Time	*no entry*
TCP/IP	
Remote TCP/IP Address	10.5.0.148
Remote TCP/IP Port	8100
Local TCP/IP	Static
Local TCP/IP COM Port	*no entry*
TCP/IP Number of Retries	*no entry*
TCP/IP Retry Delay Time	*no entry*
Satellite	
Satellite Conn. String	*no entry*
Satellite COM Port	*no entry*
Satellite Number of Retries	*no entry*
Satellite Retry Delay Time	*no entry*

Setup>Automatic Events>AutoXmit *NOT USED BY MAVERIK*	
Comm Port	*no entry*
Delay Time (Secs)	*no entry*
Repeat Time (Mins)	*no entry*
AutoXmit Alarm List	*no entry*
Setup>Automatic Events>Autoconnect Tasks	
Connection Mode	TCP/IP
Reports	PLLD Shutdown, Overfill Alarm, High Level Alarm, Sump Sensor Alarm, Dispenser Pan Alarms
Contact	Insite360 Help Desk
Trigger	On Event
Setup>Automatic Events>Device Tasks	
SITE SPECIFIC	***FOLLOW THESE EXAMPLES WHERE (product) IS THE PRODUCT LABEL AND (tank) IS THE TANK LABEL***
PLEASE ENSURE THAT PRODUCTS ARE PROGRAMMED FOR PLLD SHUTDOWN AT LOW PRODUCT LEVEL ALARM LEVELS (TANK VOLUME EQUIVALENT TO 10" PRODUCT LEVEL)	
Device	Relay 7: Overfill Alarm
Trigger (Event)	Overfill Alarm
Device	Pump 1: (product)
Trigger (Event)	(product) STP Sump Fuel Alarm
Device	Pump 1: (product)
Trigger (Event)	(tank) Tank Alarm: High Water Alarm
Device	Pump 2: (product)
Trigger (Event)	(product) STP Sump Fuel Alarm
Device	Pump 2: (product)
Trigger (Event)	(tank) Tank Alarm: High Water Alarm
Device	Pump 3: (product)
Trigger (Event)	(product) STP Sump Fuel Alarm
Device	Pump 3: (product)
Trigger (Event)	(tank) Tank Alarm: High Water Alarm
Device	Pump 4: (product)
Trigger (Event)	(product) STP Sump Fuel Alarm
Device	Pump 4: (product)
Trigger (Event)	(tank) Tank Alarm: High Water Alarm
Setup>Automatic Events>Print Tasks	

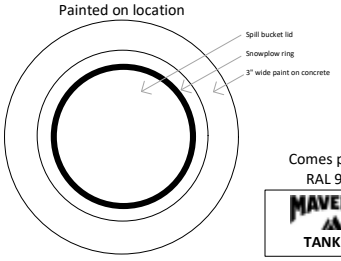
Time/Event	***NEVADA ONLY***	Monthly, 28th day of the month at 6:00 AM	
Print	***NEVADA ONLY***	Print 1: TLSIntegralPrint	
Report	***NEVADA ONLY***	Sensor History	
Setup>Automatic Events>All Tasks (display list of up to 30 programmed tasks)			
Time/Event		*no entry*	
Report/Action		*no entry*	
Contact		*no entry*	
Device/Connection Mode		*no entry*	
System Administration>Roles Admin			
Predefined Roles			
Role:	Administrator	Is Regulator?	No
		Diagnostics	Edit/Perform
		Reports	Edit/Perform
		Setup	Edit/Perform
		System Status	Edit/Perform
		System Admin	Edit/Perform
		Data Logger	Edit/Perform
		General	Edit/Perform
Role:	Maverik ASC	Is Regulator?	No
		Diagnostics	View
		Reports	View
		Setup	View, Edit/Perform
		System Status	View
		System Admin	Not Granted
		Data Logger	View
		General	View
Role:	Store Operator	Is Regulator?	No
		Reports	View
Role:	Regulator	Is Regulator?	No
		Diagnostics	View
		Reports	View
		System Status	View
System Administration>Users Admin			
Username		Rus	
Full Name		Russell Anderson	
Role		Administrator	

Email	Russell.Anderson@maverik.com
Password	Guest (DEFAULT)
Repeat Password	*no entry*
Force Change Password	*no entry*
Setup>System>Security	
Front Panel Security	*no entry*
Serial Command Port (TCP/IP INTface)	ENABLED (DEFAULT) *UNDEFINED*
SSH Port	*no entry*
HTTPS Port (Web Access)	ENABLED (DEFAULT) *UNDEFINED*
User Admin via Web	*no entry*

UNL GASOLINE Spill bucket lid & concrete paint - **Rust-Oleum Gloss White**

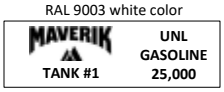
1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter U screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 9003 white color



2.

Don't paint

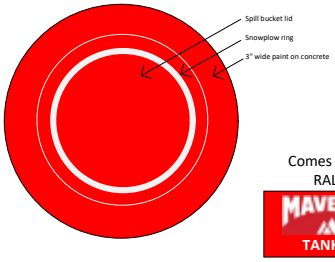


3.

PREM GASOLINE Spill bucket lid & concrete paint - **Rust-Oleum Gloss Sunrise Red**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter P screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 3002 red color



2.

Don't paint

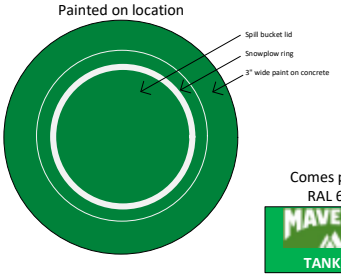


3.

DIESEL #2 Spill bucket lid & concrete paint - **Rust-Oleum Gloss Hunter Green Enamel**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter D screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 6029 green color



2.

Don't paint

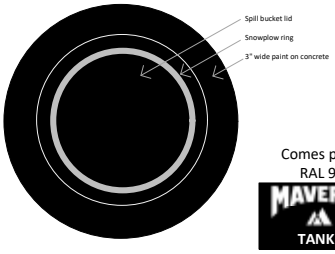


3.

DEF Spill bucket lid & concrete paint - **Rust-Oleum Gloss Black Enamel**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural stainless steel raised letters DEF screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 9005 black color



2.

Don't paint

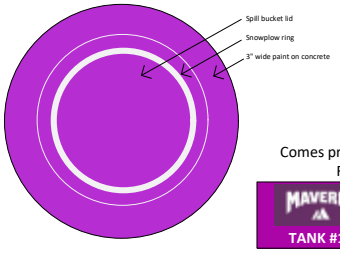


3.

ECO UNL GASOLINE (E15) Spill bucket lid & concrete paint - **Rust-Oleum Gloss Safety Purple**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter E15 screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 4008



2.

Don't paint

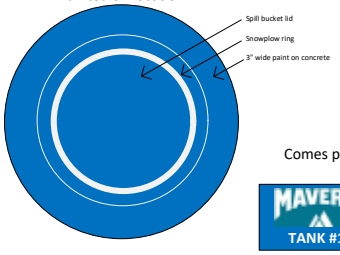


3.

ETHANOL-FREE GASOLINE Spill bucket lid & concrete paint - **Rust-Oleum Gloss Cobalt Blue**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter EF screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated RAL 5005



2.

Don't paint

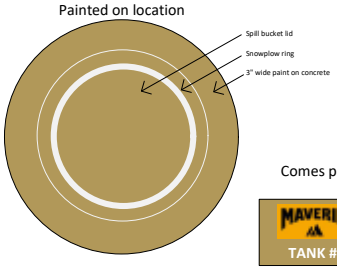


3.

BIODIESEL B100 Spill bucket lid & concrete paint - **Rust-Oleum Gloss Warm Gold Metallic**

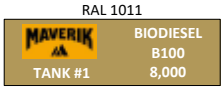
1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter EF screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated
RAL 1011



2.

Don't paint

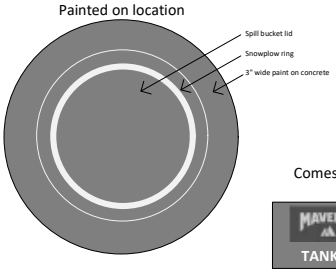


3.

E85 GASOLINE Spill bucket lid & concrete paint - **Rust-Oleum Gloss Smoke Gray**

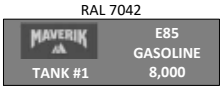
1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter EF screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated
RAL 7042



2.

Don't paint

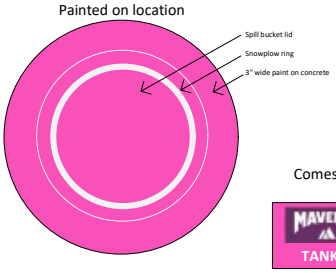


3.

MID-GRADE GASOLINE Spill bucket lid & concrete paint - **Rust-Oleum Gloss Berry Pink**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket
3. Natural aluminum OPW raised letter EF screwed into the OPW 106 Identification marker base & anchor shank

Painted on location



1.

Comes pre-powder coated
RAL 4010



2.

Don't paint

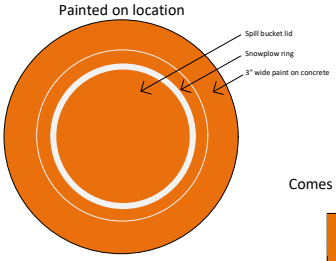


3.

VAPOR Spill bucket lid & concrete paint - **Rust-Oleum Gloss Orange**

1. Painted spill bucket lid & snow plow ring & 3" of concrete
2. Powder coated painted spring loaded laser-cut stainless steel tag around fill collar in bucket

Painted on location



1.

Comes pre-powder coated
RAL 2004



2.

SECTION 13 0201 – FUEL SYSTEM INSTALLATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the construction administration and quality control required for the installation of auto fuel dispensing systems and below grade storage equipment.

1.2 RELATED SECTIONS

A. Section 02300 – "Earthwork"

B. Section 13205 – "Underground Storage Tanks and Appurtenances"

C. Section 13210 – Underground Storage Tank Monitoring Systems"

D. Section 13215 – "Underground Storage Tank Piping"

1.3 SYSTEM DESCRIPTION

A. Fuel dispensing and storage system is to be a complete sealed system from fuel delivery ports to storage tanks to dispensing units and monitoring system. Contractor shall install systems to local jurisdictional requirements as part of the basic scope of work. Contractor shall also provide and execute such forms and verifications as may be required by local jurisdictions to certify that system is operational and in conformance with regulations.

1.4 SUBMITTALS

A. Forms attached at the end of this Section shall be completed and signed by the installation contractor in conjunction with system inspection and testing under the requirements of this Section.

1. Piping Secondary Containment Integrity Testing
2. Spill Bucket Integrity Testing Hydrostatic Test Method Single- and Double-Walled Vacuum Test Method
3. Containment Sump Integrity Testing Hydrostatic Testing Method
4. Overfill Alarm Operation Inspection
5. Automatic Tank Gauge Operation
6. Liquid Sensor Functionality Testing
7. Mechanical and Electronic Line Leak Detectors Performance Tests

B. Licensed or Certified Contractors must be used. Contractors who perform tank work are required to have a certification from the International Fire Code Institute (IFCI).

1. Contractors are required to carry proof of certification on site.

1.5 QUALITY ASSURANCE

A. The Fuel Contractor shall verify all tank installation procedures with the most recent published installation guide from the tank manufacturer or per manufacturer's instruction, whichever is stricter. If any discrepancy exists between this specification and the manufacturer's installation guideline contacts the manufacturer's representative immediately for resolution. All mandated Federal, State and Local regulations shall govern on all installations.

B. Installation contractors are limited to those listed at the end of this Section.

1.6 COMMISSIONING

A. After the systems and components have been installed and tested to the contractor's satisfaction, the Owner's Construction Manager shall be notified in writing that the system is ready for filling to between 60 and 90 percent capacity.

B. After filling, the contractor shall retest and verify that the system is in compliance with fuel dispensing and storage system regulations. Forms attached at the end of this Section shall be completed and executed based on the retesting of the filled system and submitted to the Construction Manager with final pay request.

PART 2 – PRODUCTS
NOT USED

PART 3 – EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. As listed at the end of this Section.

3.2 INSTALLATION

A. If operation of Stage II Vapor Recovery System equipment is not required by the local jurisdiction, State or governing Air District Authority the Stage II System components below grade shall be installed during site development. System shall be capped and sealed as shown on Drawings for future use. Final hookup and system testing is not required.

3.3 SCHEDULE OF PRE-APPROVED FUEL SYSTEM INSTALLATION COMPANIES (Companies not on this list need approval from Maverik Construction Manager to bid on projects):

Leonard Petroleum Equipment
PO Box 170219
BOISE, ID 83717
Kent Storer
Phone: (208) 336-1155 **Fax:** (208) 384-1298

Petroleum Equipment Company
1174 South 300 West
SALT LAKE CITY, UT 84101
Landon Lewis
Phone: (877) 841-7867 **Fax:** (801) 487-3703
(801) 487-8276

Petroleum Installation Specialists
3282 West 9000 South WEST JORDAN, UT 84088
Dennis Taylor
Phone/Fax: (801) 568-0335
(801) 232-2266

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SECTION 13 0205 - UNDERGROUND STORAGE TANKS AND APPURTENANCES

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies materials and labor for installing and testing underground storage tanks.

B. The Owner will furnish all specified items as listed in the drawings and specifications. Contractor shall furnish appurtenant accessories not listed in the drawings and specifications as required to complete the entire installation.

C. The Contractor shall install all equipment furnished by Owner on the drawings.

D. The Contractor shall contact local environmental/regulatory department and Fire Marshal at least three days (or at direction of jurisdiction) prior to installation of tanks. Contractor shall be responsible for coordination of inspections as required by local jurisdiction for approval or license requirements.

E. If secondary containment system is installed, it shall pass a post-installation test which meets the approval of the jurisdiction.

F. The installer has been adequately trained as evidenced by a certificate of training issued by the tank and piping manufacturer.

G. The installer has been certified or licensed by the Local Contractors State License Board.

The underground storage tank, primary piping and secondary containment, are installed according to applicable national standards and manufacturer’s written installation instructions.

Work listed in the manufacturer’s installation checklist has been completed.

H. The installation has been inspected and approved by the local agency, or, if required by the local agency, inspected and certified by a registered professional engineer who has education in and experience with underground storage tank system installation.

1.2 RELATED SECTIONS

A. Section 02300 – “Earthwork”

B. Section 13210 - Underground Storage Tanks Monitoring Systems

C. Section 13215 - Underground Storage Tanks Piping

1.3 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA)

B. International Fire Code Institute (IFCI)

C. Licensed or Certified Contractors must be used. Contractors who perform tank work are required to have a certification from the International Fire Code Institute (IFCI).

1. Contractors are required to carry proof of certification on site.

D. The Contractor shall verify all tank installation procedures with the most recent published installation guide from the tank manufacturer or per manufacturer's instruction, whichever is stricter. If any discrepancy exists between this specification and the manufacturer's installation guideline, contact the manufacturer's representative immediately for resolution. All mandated Federal, State and Local regulations shall govern on all installations.

PART 2 – PRODUCTS

2.1 TANKS

A. Fiberglass reinforced plastic (FRP), double walled underground storage tanks (Containment Solutions or Xerxes) with 22" manway and standard 4" bung fittings, unless noted otherwise. Sizes and fittings shall be as shown on the contract drawings and these specifications below.

	Nominal Gallons	Double Wall (size)
a.	25,000 1 compartment	Varies per manufacturer
b.	25,000 2 compartment	Varies per manufacturer
c.	25,000 3 compartment	Varies per manufacturer
d.	40,000 1 compartment	Varies per manufacturer
e.	40,000 2 compartment	Varies per manufacturer
f.	40,000 3 compartment	Varies per manufacturer

B. Cut the submerged drop tube for product fuel tanks at a 45° angle so the lowest point will be 3" minimum/4" maximum from the bottom of the tank. The highest point must be a maximum of 6" from the bottom of the tank. The 6" maximum dimension is critical due to air pollution rules. Orient the submerged drop tube to direct incoming product toward the opposite end of the tank. Refer to installation drawings for additional details from tank manufacturer.

C. Fuel Dispenser, Hose and Nozzle:

1. UL listed electric, 115/230 VAC, 60 HZ, 10 max. GPM remote dispenser, with card reader, meter and blender, complying with NFPA 30A and UFC 5202. Dispenser shall have a spill containment sump and will be mounted on a concrete island with steel forms. Dispenser shall be a Wayne Ovation, Gilbarco Encore 700 5 or Bennett product, multi hose blending dispenser. Dispenser shall have the following features:
2. Display module will be eight-digit money and nine-digit volume electronic totalization with identification for product volume and cash.
3. Memory backup will have data storage in non-volatile memory. Sale display remains visible for approximately 15 minutes after power loss. Backup is at POS, not at dispenser.
4. Pulser shall be intrinsically safe, solid state, mounted above meter.
5. Blend/flow control valve shall be state of the art, proportional flow control valve insuring accurate blending of the feedstocks. Regulates fuel flow rate through hoses to 10 GPM maximum as mandated by EPA. Product through hose outlets controlled by dedicated solenoid valves.

6. Meters shall be reliable micro-accurate, two piston model. Patented differential displacement principle provides proportional calibration. All materials selected for fuels compatibility, corrosion resistance and long life.
7. Card reader will have full support of debit/ATM and credit card processing, EMV keypad, built-in annunciator, backlit 2-16-character LCD display and built-in thermal receipt printer.
8. Dispensing hose shall be 3/4" diameter, compatible with diesel and unleaded gasoline, 9 - 6" long. Spacer hose shall be 3/4" diameter, compatible with diesel and unleaded gasoline, 8" long Goodyear hardwall curb hose.
    a. Dispensers will have additional items (nozzle, swivel, reconnectable breakaway, accessible keypad) as specified by Owner.

9. Dispenser sump shall be a deep/extended sump approximately 31" deep x 17" x 40.6" (verify size with manufacturer), with stabilizer bar, and shear valves. OPW 10P-0152.

2.2 ACCESSORIES

A. Hold-Down Materials:

1. Precast, reinforced concrete deadmen, 12" x 12" or 12" x 24" in cross-section, with chamfered edges, provided by Maverik, per Tank Manufacturer. Length and quantity, per Tank Manufacturer, follows: 1/2" diameter galvanized steel anchor loops are to be cast into deadmen at locations shown on drawings. Precast material shall have achieved its ultimate compressive strength of 2500 psi (28 days) prior to installation.

B. Turnbuckles (Dropped-Forged, Galvanized): Hook 1-1/4", Jaw 3/4", Eye 3/4", minimum working load limit 5200 lbs., furnished by tank manufacturer.

C. Protective Coating: Prior to backfilling tanks, coat all exposed steel cables, loops and hardware per manufacturer’s requirements.

D. UST Appurtenances:

1. Refer to Drawings.

E. Filter Fabric:

1. Reemay, Inc. - Typar 3401 or Typar 3341
2. Amoco Fabrics & Filters - Amoco CEF 4545
3. Hoechst Celanese Corp. - Trevira S1125 or fabric approved by the tank manufacturer. Do not use polyethylene as a filter fabric.

F. Backfill And Bedding Material:

1. Materials shall be installed per Section 02300
2. Backfill per manufacturer guidelines. Backfill must be certified by supplier.
3. Pea Gravel: Must consist of clean, naturally rounded aggregate with a mix of particle sizes not less than 1/8" or more than 3/4". No more than 5% may pass the #8 sieve. Dry gravel density must be a minimum of 95 pounds per cubic foot.
4. Crushed Stone or Gravel: Must be washed with angular particle size not less than 1/8" or more than 1/2". No more than 5% may pass the #8 sieve. Dry gravel density must be a minimum of 95 pounds per cubic foot.

G. Signs:

1. Metal sign with the words "NO SMOKING OR OTHER SOURCES OF IGNITION." Letters shall be no less than 4" in height and will be red on a white background.

PART 3 – EXECUTION

3.1 HANDLING OF UNDERGROUND STORAGE TANKS (UST):

A. The Contractor is responsible for off-loading the tanks from the delivery vehicle. A crane or equipment of sufficient lifting capacity must be used. Actual weights shall be verified with manufacturer prior to submitting a bid.

B. Lifting and Moving: When lifting or moving a UST always use properly sized equipment and lift by lifting lug(s). On large tanks, greater than 8 diameter, use a spreader bar to ensure a lift angle of at least 45 degrees at each lifting lug. Never roll or use cables or chains around tank. Set on a surface per manufacturer's recommendations, free of rocks and foreign objects.

C. Exception: Tank can be rolled up to 90 degrees on manufacturer recommended surface when performing the "pre-installation" testing.

D. Chocking: Tanks are to be chocked in accordance with manufacturer s recommendation until ready for installation. If windy conditions exist or are expected, anchor tanks using minimum 1/2" nylon or hemp rope over each tank and secure to stakes of adequate size to prevent movement of the tanks.

E. Openings: All tanks are shipped with dust covers in each opening. Dust covers are to remain in each opening until ready for the pre-installation testing. All tanks must have either a dust cap in place or a 5 psi pressure relief valve in place at all times.

F. Damage:

1. Inspect all tanks carefully for signs of damage upon receipt and prior to off-loading from the delivery truck. Note any damage on the shipping documents and notify the Owner s inspector. Contact the tank manufacturer for additional information.
2. If tank is damaged, do not attempt repairs or off-loading. Owner s inspector is to be notified and will determine the course of action that will be followed.
3. Contractor is responsible for verifying that there is not brine leakage on secondary tank wall. If there is leakage, do not attempt repairs or off-loading; notify Owner's inspector.

3.2 INSTALLATION QUALITY CONTROL:

A. Take internal diameter measurements at the fill and remote pump openings on tanks. The Contractor, witnessed by the Owner s inspector, is responsible for making and recording these measurements on a form provided by the tank manufacturer. Take the first set of measurements prior to placing any backfill around the tank. The second set of measurements is to be taken when the backfill has reached subgrade (prior to pouring the concrete slab).

B. The Contractor is to stop work if the difference between any 2 sets of readings is greater than the manufacturer s maximum allowable deflection. Notify the Owner s inspector, who will determine the course of action. Contact the tank manufacturer for further guidance.

C. Pre-Installation Testing: All tanks must be tested for leaks prior to truck unloading and installation. Use the visual air/soap test.

D. Visual Air/Soap Test:

1. Warm weather soap solution - 5 gallons of water with 8 oz. of household dishwashing detergent.
2. Freezing conditions soap solution - substitute 1 gallon of automotive windshield washer solution for 1 gallon of water.
3. Cover all fittings with soap solution.
4. Carefully inspect for leaks as indicated by bubbles.

3.3 SETTING:

A. Set tanks on prepared bed with the tanks level.

3.4 INSTALLATION PROCEDURE:

A. Prepare the tank hole to receive hold-down deadmen. Install shoring (if required).

B. Pump water out of the tank hole if required. Keep water out of the tank hole until tanks have been set, tied down, ballasted and backfilled.

C. Lay deadmen along each side of tank, parallel to tank.

D. Position tank manufacturer supplied anchor straps per manufacturer's installation instructions.

E. Fasten galvanized turnbuckles through deadman anchor and through the end point of the hold down strap.

F. Make sure each deadman section has at least 2 anchor points. The tank must not overshadow the deadman anchor.

G. Connect all straps with turnbuckles then tighten uniformly with other straps. Straps should be snug but cause no tank deflections.

H. Ballasting (if required):

1. Only clean, potable water shall be used when ballasting the tank. The tank may be ballasted after the backfill is even with the top of the tank and post-installation testing has been successfully completed. Only under wet-hole conditions as described in the installation manual should ballast be added before the backfill is even with the top of the tank. When filling the tank, make sure the tank is properly vented. The vent must be large enough to allow the displaced air to escape.
2. Provide materials and labor to ballast underground storage tanks, as required, with water. Follow underground storage tank manufacturer's installation instructions for proper ballast procedure. Do not ballast underground storage tanks with product.
3. Do not install STP Pump while ballasting.

I. Venting: Vent the primary tank as shown on the drawings and as required to conform to all Federal, State and Local regulations.

J. Interstitial Monitor: An electronic hydrostatic sensor shall be provided to monitor the interstitial wet space as specified in the equipment list section of this specification.

K. Installing the Containment Sump:

1. The containment sump must be watertight to prevent liquid ingress or egress. Sand and clean all joint areas and apply adhesive to tank collar and turbine containment sump. Install as shown on plans.
2. Tanks should not have any unused tank openings, except in a containment.
3. Cut all openings through the containment sumps and install compression or boot type fittings for all lines (product and electrical conduit).
4. Liquid sensing probes shall be installed in each sump where fuel may be present.
5. Double wall piping must have drainage openings that drain into the sump area.

L. Hydrostatic Water Test: Test joint seal between the collar and turbine enclosure and all field mounted fittings by filling sump with water above all penetration fittings. Mark level in sump with grease pencil and inspect outside of sump for leaks at penetration fittings and collar glue joint. Maintain water in sump for 12 hours.

M. Installing the Spill Containment Fill Box: The spill containment fill box must be liquid tight. Test all fill boxes by filling with water for a minimum of one hour. There should not be a drop in the water level during this test. Do not drain water into the tank.

3.5 EXCAVATION AND BACKFILL:

A. Excavate only to the depths required by the plans, or as instructed by Owner’s representative and/or as per manufacturer s recommendations. If unexpected water conditions or rock is encountered, immediately contact the manufacturer s representative for instructions before proceeding with the excavation.

B. Tank Hole Size in Stable Soil: Size excavation perimeter to allow 36" minimum between tanks, tank sides, end caps and the wall of the tank hole.

C. Filter fabric shown on plans shall be used to line the entire tank hole for new tank installations.

D. Tank Hole Size in Unstable Soil:

1. Unstable soil is defined as having less than 750 lbs./sq. ft. cohesion, as calculated from an unconfined compression test, or soils with an ultimate bearing capacity of less than 3,500 lbs./sq. ft. Loose sand, muck, bog, peat, swamp or landfill where soil is soft are generally considered unstable soils.
2. Size excavation perimeter to allow 36" minimum between tanks and a minimum of half the tank diameter between the tank sides, end caps and the wall of the tank hole.
3. Filter fabric shall be used to line the entire tank hole for new tank installations.
4. Temporary shoring may be used to stabilize the walls of the tank hole, at the discretion of the Contractor and/or the Owner s inspector. If permanent shoring is used, follow "Stable Soil" size criteria. Refer to "Alternate Backfill Materials," below.

E. Depth of Tank Hole: The Fuel Contractor is responsible for establishing the tank hole depth, considering the length of piping runs, to the dispensers and vent risers, pipe burial depth, yard slope and the following criteria: (Measure at the Remote Pump opening.)

1. A minimum of 12" of backfill material is required under the tanks.
2. The minimum depth of cover is 3'-6" and the maximum is 7'-0" or per city requirements (Las Vegas).
3. Product lines shall be sloped 1/4" per ft. from dispensers to the tanks. Minimum slope is 1/8" per ft.
4. Vent and vapor return lines shall be sloped 1/4" per ft. toward the tanks. Piping slope should never be less than 1/8" per ft.
5. Minimum 6" pipe separation for all fiberglass piping at crossovers.

F. Tank Hole Liner:

1. The Contractor shall provide a Filter Fabric Tank Hole Liner to cover the entire side and bottom of the tank hole. Lay the fabric with 2' minimum overlaps. Bedding material, deadmen anchors and sample wells are to be placed on the top of the filter fabric. Excess fabric at the top of the hole should be folded over the backfill material at subgrade level.

G. Safety Requirements:

1. No person shall enter a tank hole excavation below the 4 ft. deep level unless the walls are shored, or side sloped as prescribed by current OSHA regulations.

H. Backfill Procedure:

1. Place backfill evenly around tanks. Push backfill completely underneath the tank between ribs and under the end caps. Procedure can be done from bank or adjacent tank top by trackhoe or gravel shooter or other approved method.
2. Place backfill evenly around the tanks "working" the backfill between the ribs and under the end caps. Add backfill evenly around the tanks up to the tops of the tanks.
3. Backfill to subgrade after piping and testing is completed.

I. Signs: "NO SMOKING OR OTHER SOURCES OF IGNITION" sign shall be posted in a conspicuous location visible from the dispensing area.

END OF SECTION 13205

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SECTION 13 0210 - UNDERGROUND STORAGE TANKS MONITORING SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies the materials, equipment, and labor required to furnish and install a monitoring system for level gauging, inventory control, tank testing and leak detection.

B. The following equipment will be supplied by Owner and installed by Contractor. Contractor to contact a manufacturer's representative to program unit after installation.

1.2 RELATED SECTIONS

A. Section 02300 – "Earthwork"

B. Section 13205 - Underground Storage Tanks and Appurtenances

C. Section 13215 - Underground Storage Tanks Piping

1.3 SYSTEM DESCRIPTION

A. The system(Veeder-Root TLS-450 Plus, provided by Owner) shall provide the functions of tank level gauging/inventory control, tank testing and leak detection. It shall consist of a microprocessor controller, interstitial sensor, sump sensor and liquid level probe located in each underground storage tank (UST). The system shall be capable of monitoring the level of product and water, gross product volume, product temperature, deliveries, and tank and piping leakage. Monitoring system shall have the following features:

1. All functions shall be programmable through a panel-mounted keypad or through an ethernet connection for remote access.
2. System shall report the following conditions via external modem and panel-mounted display. Each report shall be fully programmable by the Contractor:
    a. Low product will signal a predetermined fuel delivery point
    b. High water will warn of excessive water accumulation
    c. Detection of theft or rapid product loss
    d. Hardware failure
    e. Product level and volume
    f. Record of product deliveries
    g. Other features as determined by the Owner and/or ATG basic setup standards

B. To provide similar operation at its various fuel facilities, to facilitate maintenance and training, and to minimize spare parts inventories, the Owner has identified the acceptable and compatible equipment for tank monitoring: The Veeder-Root TLS-450 Plus monitoring system will be used.

1.4 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store equipment off the ground in ventilated and protected manner to prevent physical damage or deterioration from moisture.

1.6 WARRANTY

A. Installer shall warrant that labor performed on-site shall be by a manufacturer's authorized representative.

1.7 TRAINING

A. Conduct one training session to familiarize Owner's personnel with the operation and maintenance of the tanks and appurtenances.

PART 2 – PRODUCTS

2.1 TANK LEVEL GAUGING AND INVENTORY CONTROL:

A. System shall collect product height and temperature data from a magnetostrictive level probe and compute gross and temperature-compensated net gallons. The Owner may choose from inventory or delivery information to generate a complete set of inventory or delivery printed reports. Automatic reporting times shall be programmable.

B. System shall automatically generate an inventory increase report when product has been delivered. Report shall include date and time of the delivery, starting and ending volumes in the tank, starting and ending temperatures of the fuel, and inventory increase amount.

2.2 IN-TANK LEAK TESTING:

A. System shall employ an in-tank probe based on the magnetostrictive principle for liquid level measurement and in-tank leak detection. Probe shall be Veeder-Root Series 0846397-1XX for fuel and 0846397-4XX for DEF, capable of performing a leak detection test to 0.1 gph. Probe shall utilize shielded cable rated less than 100 picofarad per foot and be manufactured with a material suitable for the environment, such as Belden 88760, 8760, 8770 or similar, or Carol C2534.

B. Probe shall be certified by a Third Party as meeting the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems" (0.2 gph monthly monitoring) and "Volumetric Tank Tightness Testing Method" (0.1 gph annual tank tightness test).

C. System shall have the capacity to perform leak tests on demand. System shall perform validity checks on leak tests and indicate test results.

2.3 PIPING LEAK DETECTION:

A. System shall monitor piping using a Veeder Root Series 794380-208 Piping Sump Sensor. System shall provide audible alarm and visual indication in the event of a piping or submersible pump leak. Sensor shall utilize shielded cable rated less than 100 picofarad per foot and be manufactured with a material suitable for the environment, such as Belden 88760, 8760, 8770 or similar, or Carol C2534.

2.4 ALARMS:

A. System shall provide audible and visual indication of the following alarm conditions:

1. Maximum product level
2. High level limit
3. High water
4. Low inventory (delivery needed)
5. In-tank leak
6. Piping leak
7. Sudden loss (theft)

B. Operator shall be able to disable the audible portion of the alarm. However, visual alarm shall not be capable of being disabled until the alarm condition has been corrected.

C. System shall have an external audible and visual alarm with acknowledgment switch, housed in a watertight gasketed enclosure.

2.5 COMMUNICATIONS:

A. System shall have a minimum of two built-in inputs for external inputs, as well as two output relays for overfill alarm and external audible/visual alarm devices.

B. System shall have an RS-232 and Ethernet TCP/IP port to allow central computer to interrogate in remotely.

C. System shall be installed complete with all software required to perform the functions specified in this section.

2.6 DIAGNOSTICS/TROUBLESHOOTING:

A. All diagnostic information shall be generated by the system itself. Diagnostic information shall not be alterable by the user. Diagnostic information shall include data on the probes, sensors, software, in-tank leak results, interstitial leak results, and alarm history.

B. All diagnostic information shall be capable of being printed by the system s integral printer.

2.7 CONSOLE:

A. Veeder-Root TLS-450 Plus shall be wall-mounted at locations shown in drawings.

2.8 TANK TIGHTNESS TEST:

A. Tank testing to be performed per manufacturer's recommendations, and passing test provided to Owner's Representative.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Certified Installer shall install the monitoring system in strict accordance with the manufacturer's instructions. Provide and install all required electrical wiring, conduit, junction boxes and auxiliary components as required. All electrical work shall be in accordance with the National Electrical Code.

3.2 MANUFACTURER'S SUPPORT/FIELD SERVICE:

A. Manufacturer (hired by Owner) shall provide technical phone support from 8 a.m. to 7p.m. PST, and via local, authorized distributors.

B. Manufacturer's authorized representative (hired by Owner) shall oversee installation of the system and provide on-site training of the Owner's personnel on installation, startup, programming, operation and troubleshooting of the monitoring system. Manufacturer shall certify to the Owner that authorized representatives have successfully completed manufacturer's training courses.

C. Manufacturer shall maintain an ISO-9001 rating ensuring quality management of design, manufacturing, training and technical documentation.

3.3 TESTING:

A. Notify the Owner at least 5 calendar days prior to the commencement of system testing.

B. Test each component of the system for calibration and proper operation in accordance with the manufacturer's instructions.

C. Testing shall be documented by the Contractor and witnessed by the Owner's Representative.

D. Record the date and time of the test, the name of the tester and affiliation with the project, and the names of each individual witnessing the test.

E. Record the test method, duration, results and any exceptions.

F. Provide 3 copies of the record of testing to the Owner.

END OF SECTION 13210

SECTION 13 0215 - UNDERGROUND STORAGE TANKS PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies materials and labor for installing and testing underground double wall flexible product lines, single wall Fiberglass Reinforced Plastic (FRP) vent piping and flexible containment piping.

B. The Owner will furnish all specified items as listed in the drawings and specifications. Contractor will furnish appurtenant accessories not listed in the drawings and specifications as required to complete the entire installation.

C. The Contractor will install all equipment furnished by Owner on the drawings.

D. All secondary containment systems shall pass a post-installation test which meets the approval of the local agency.

E. Contractor shall certify that the installation of the tanks and piping meets the following conditions.

F. The installation has been inspected and approved by the local agency, or, if required by the local agency, inspected and certified by a registered professional engineer who has education in and experience with underground storage tank system installation.

1.2 RELATED SECTIONS

A. Section 02300 – Earthwork

B. Section 13200 - Underground Storage Tanks and Appurtenances

C. Section 13210 - Underground Storage Tanks Monitoring Systems

1.3 SUBMITTALS

A. Within three weeks of Notice to Proceed, Contractor shall provide three sets of the following:

1. Shop drawings of actual piping runs.
2. Catalog information on piping and related fittings including elbows, couplings and reducers.
3. Installation instructions for piping and related fittings.

1.4 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA)

B. International Fire Code Institute (IFCI)

1.5 DELIVERY, STORAGE, AND HANDLING

A. Fiberglass and Flexible Pipe: Handle pipe carefully and according to the manufacturer's guidelines. Protect against abrasion from sharp or hard objects; impact damage from improper storage, transporting, laying or backfilling. Inspect all pipe for damage prior to installation. Engineer and installer to verify pipe requirements with local jurisdiction prior to bidding and installation.

B. Steel/Iron Pipe and Fittings: Protect against damage to the protective coating/wrapping.

C. Flex Connectors: Protect against damage. Inspect all pipe for damage prior to using in the piping system.

PART 2 – PRODUCTS

2.1 PRODUCT LINES, VENT AND VAPOR RECOVERY PIPING:

A. Product lines to be 1-1/2", 2", and/or 3" double wall flexible pipe (basis of design: OPW Flexworks Pipe), routed in 4" and/or 6" minimum flexible duct. Vent lines to be 2" (FRP) single wall pipe. Siphon lines to be 2" (FRP) single wall pipe.

B. Flexible Pipe: Pipe runs are to be of flexible pipe and sized in accordance with plans. Pipe and fittings shall be UL approved, double or single walled, non-metallic, for underground piping of petroleum products. The pipe shall have metallic fittings at sump locations with test boots and connector tubes for secondary air testing. Non-metallic fittings are to be those manufactured by the supplier of the pipe being used. Install pipe fittings in accordance with manufacturer's instructions.

C. Approved Flexible Pipe:

1. Double Wall Product Pipe 1-1/2", OPW Flexworks C15A, 2" OPW Flexworks C20A
2. Single Wall Vent Pipe – NOV, Ameron L3000, Smith Red Thread II

D. Fiberglass Pipe (verify requirements with local jurisdiction): Pipe runs are to be of "fiberglass" pipe and sized in accordance with plans. Pipe and all joints and fittings shall be UL approved, single walled, non-metallic, for underground piping of petroleum products. The pipe shall have bell and spigot joints. Non-metallic fittings are to be those manufactured by the supplier of the pipe being used. Install pipe fittings in accordance with manufacturer's instructions.

E. Approved Fiberglass Pipe:

1. Red Thread II Pipe System
2. Dualoy-3000 Pipe System

F. Steel (Galvanized or Black Iron) Pipe:

1. Do not used standard couplings normally furnished with the pipe; use fittings described below. Steel pipe and fittings are to be used only within the tank sump at the tank connection. Steel pipe is to be used for riser to emergency shut-off valve or pump connection at pump block. Above ground vent riser is to be steel pipe.
   a. Schedule 40 (ASTM A 120) Steel Pipe
   b. 250 # Railroad Unions
   c. 150 # Malleable Iron Fittings

G. Flex Connectors: Steel braided, fire-rated within tank sump and dispenser sump. Hose Master or equal. Use Flex connectors (if approved by Engineer) as an alternate to flexible product piping at pump connection, vent extractor, vent riser transition and dispenser sump riser connection.

2.2 BACKFILL AND BEDDING MATERIAL:

A. Materials and installation shall be in accordance with Section 13205 and 02300

PART 3 – EXECUTION

3.1 INSTALLATION

A. Laying of Pipe:

1. All piping installations shall conform to pipe manufacturer s specifications and installation guidelines.
2. All product lines are to be secondarily contained.
3. Interior surface of all pipe and fittings must be free from dirt, scale, metal, fiberglass particles, etc., before connecting.
4. Product piping must be pitched upward continuously from tanks to dispensers a minimum of 1/8" per foot. (1/4" per foot is preferred for product piping and mandatory for vent piping.) Traps or sags will not be permitted. Group all piping and locate as shown on the plans. Lines are to be laid straight, using fittings for directional and elevation changes.
5. Flexible piping turns should not be less than 36" bend radius. Piping trenches should be cut with sweeping turns.
6. Do not support piping with foreign objects, such as scraps of wood, pipe, etc.
7. Use manufacturer s crossover supports at all piping crossovers.
8. Bedding of piping runs and backfill of pipe trenches, refer to section entitled"Backfill and Bedding Material."
9. Perpendicular penetrations of containment sumps are preferred, 10 degrees is the maximum allowable penetration angle.
10. Vent riser must be 5 -0" min. distance from any property line per UFC Code, 1998 Edition.

B. Cutting of Pipe:

1. Fiberglass Pipe: Cut with a fine-toothed hacksaw blade or an abrasive wheel on a circular power saw. Use a saw guide or "wrap around" to ensure a square cut end. Cut pipe end must be within 1/8" of square.

2. Steel Pipe: Cut with a hand or power-operated pipe cutter, as in normal fitting practice.

C. Flexible Pipe: Cut with pipe manufacturer's pipe cutter tool.

D. Tapering and Reaming:

1. Fiberglass Pipe: All cut ends must be tapered using one of the tapering tools available from the pipe manufacturer. Protect pipe tapering to prevent damage to pipe. The finish taper shall be smooth, clean and free from surface defects. The length of taper for 2" diameter pipe is 1-5/8" and for 3" diameter pipe is 1-3/4". For other size pipe consult pipe manufacturer's instructions.
2. Steel Pipe: Ends are to be reamed.
3. Flexible Pipe: Does not apply.

E. Bonding and Adhesive Systems (Fiberglass Pipe):

1. All fiberglass pipe surfaces to be bonded shall be cleaned with solvent as supplied by pipe manufacturer. If tapered section is wet or moist, dry with propane torch - do not overheat or burn the pipe. If temperature is below 60°F (16°C) warm all tapered surfaces with heat gun - do not overheat or burn the pipe fitting. Bell and spigot joints are to be made up with epoxy adhesive as recommended by the pipe manufacturer. Adhesive shall be mixed thoroughly in accordance with manufacturer's instructions and shall be applied to both surfaces. Insert the spigot end into the bell using a slight turning motion (one half turn to a full turn is necessary) and push. Apply pressure until mechanical lock is achieved. Back axial pressure should be maintained on all previously assembled joints to reduce the chance of separation.
2. Inspect all fittings for proper alignment as possible "back out" at the joints may occur.
3. Follow pipe manufacturer's recommendations on cure time before disturbing joints or testing. If it is anticipated that the temperature will drop below 60°F (16°C) at any time during the curing process, heat shall be applied to the joints. Only chemical or electrical devices recommended by pipe manufacturer are acceptable for this purpose. No open flame or sparking devices are to be used.

F. Threaded Joints: Threaded joints must be reamed and have clean cut, perfect threads and be made up with non-hardening joint compound insoluble in petroleum products.

G. Typical Joint Compound:

1. Rectorseal
2. Permatex 57 or approved equal
3. Gasoila Thread Sealant

H. Fiberglass to Steel Pipe Connections: Fiberglass threaded end adapters are to be threaded into the steel pipe or fitting before bonding onto the fiberglass pipe.

I. Couplings for Flexible Pipe: Strip off a 2" section of the outer stand-off containment jacket using the pipe manufacturer's jacket cutter tool, per manufacturer's instructions.

1. Install pipe coupling using the pipe manufacturer's coupling machine per manufacturer's instructions.

J. Special Fittings:

1. The shear valve at the base of the dispenser is to be secured in position with a steel stabilizer as detailed on the drawings.
2. Termination assembly and termination plug to be used at secondary piping termination into building.
3. Test boots for double wall flexible piping must be installed to the ends of each flexible pipe section in order to provide a means of air pressure integrity testing the interstitial space of the flexible pipe. After all pipe sections have been inserted into the containment sumps and before pipe couplings are connected to the pipe fittings or pipe adapters, the test boots shall be installed. The test boot has an outlet opening located on the bottom of the connection of the connector tubes and test tubes which are used for performing an air pressure integrity test.

K. Pipe Wrapping: All underground steel pipe and fittings shall be field primed and wrapped. Wrapping material shall be 35 mil polyethylene tape "Polyken 930" manufactured by the Kendall Company or equal.

1. Wrap overlap shall be one-half width of wrapping material.
2. Wrap 1-1/2" and 2" fittings with Polyken 900 (12 mils) with 60% overlap. In difficult areas Polyken 931 can be used before wrapping with Polyken 900.
3. Primer shall be Polyken 927 (above 40°F) or Polyken 919 (above 10°F).
4. Exceptions: Do not wrap the union at the remote pump and FRP pipe/flex connector connections.

L. Setting and Bedding Pipe:

1. A 4" minimum bed of backfill materials is to be placed in all piping trenches. Smooth, compact and slope bedding material to allow a slope of 1/4" per foot toward the tanks. In extreme conditions, 1/8" per foot may be used if approved by Owner's inspector.
2. Piping shall be placed on prepared bed in such a manner as to minimize points at which one pipe may cross over another pipe. At points where piping must cross over, a minimum of 4" must separate the pipes. When crossing over flexible piping use manufacturer's crossover supports.
3. When piping is placed on the bed, proceed to "first test" (below) prior to backfilling trenches.

M. Cleaning Solvents: Remove any accumulation or accidental spill of pipe cleaning solvents on the tank immediately with a clean cloth. After the piping is completed, inspect the containment sump and other collection points for pipe cleaning solvents. Contractor will be responsible for any damage to tank resulting from an accumulation of pipe cleaning solvent.

N. Repair of Piping: Any damaged piping must be replaced. Repair of piping using field cut half section of pipe is not acceptable. If approved by manufacturer's representative, repair using manufacturer supplied pipe fittings and procedures is acceptable. Repaired pipe requires complete testing using procedures below.

O. Flex Connector Boots: If a flex connector is not in a containment sump it must be in an isolation boot. Move the isolation boot to inspect and test all primary piping and flex connectors.

3.2 FIELD QUALITY CONTROL

A. Notification: The Owner's inspector **must** observe all tests. Notify at least 24 hours in advance of any tests.

B. Responsibility: The Contractor is responsible for all labor, material and equipment to conduct air pressure tests of all product, vent and vapor recovery piping. All testing procedures shall be verified with the most recent pipe manufacturer installation specifications.

C. Tests:

1. Before Starting the Testing Procedures: If the lines for any reason contained petroleum products, drain lines and apply a pressure of 50 psi (do not exceed 60 psi) with nitrogen instead of air to each system and proceed as described below.
2. The tank must be isolated from the piping system when pressure testing the piping. Tank pressure in excess of 5 psi will void all warranties.
3. All piping shall be tested before backfilling and continuously thereafter until backfill and setting of concrete is completed and the Owner's inspector accepts test. Before backfilling, each pipe system shall be flushed clean. Test the product and vapor piping by isolating the lines from pumps, dispensers and tanks, then apply air pressure of 50 psi (do not exceed 60 psi) to each primary line and soap test all joints for leaks (soap bubbles). Leave the pressure gauges and maintain the test pressure during the entire backfilling process. If no perceptible change in pressure has occurred at the end of the test period, the system shall be considered acceptable. Verify backfill and testing requirements with local ordinances and requirements and follow whichever is more restrictive.
4. Maintain test gauges at manufacturer's recommendation (do not exceed manufacturer's pipe burst rating) air pressure on product piping and 10 psi on secondary until entire area over tanks and piping is backfilled and paved.
5. All tanks and lines shall be pressure tested (precision test) in accordance with NFPA 329 after paving and all pipe connections are completed and before placing facilities in operation.
6. In addition, all product lines shall be tested at manufacturer's recommendation (do not exceed manufacturer's pipe burst rating) with a (Petro-Tite) line tester prior to acceptance by Owner's inspector to place the facility in operation.

END OF SECTION 13 0215

APPENDIX C-2

PIPING SECONDARY CONTAINMENT INTEGRITY TESTING

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the integrity of the interstitial space of double-walled piping. See PEI/RP1200 Section 5 for the test procedure.						
Tank Number						
Piping Run						
Piping Material						
Product Stored						
Test Start Time						
Initial Test Pressure, psig (Test procedure specifies 5 psig.)						
Test End Time						
Final Test Pressure, psig						
Pressure Change (No reduction in pressure allowed for pass.)						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-3

SPILL BUCKET INTEGRITY TESTING HYDROSTATIC TEST METHOD SINGLE- AND DOUBLE-WALLED VACUUM TEST METHOD

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the leak integrity of single- and double-walled spill buckets. See PEI/RP1200 Section 6.2 for hydrostatic test method, Section 6.3 for single-walled vacuum test method and Section 6.4 for double-walled vacuum test method.						
Tank Number						
Product Stored						
Spill Bucket Capacity						
Manufacturer						
Construction	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled	☐ Single-walled ☐ Double-walled
Test Type	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled	☐ Hydrostatic ☐ Vacuum ☐ Single-walled ☐ Double-walled
Spill Bucket Type	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor	☐ Product ☐ Vapor
Liquid and debris removed from spill bucket?*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Visual Inspection (No cracks, loose parts or separation of the bucket from the fill pipe.)	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Tank riser cap included in test?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Drain valve included in test?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Starting Level						
Test Start Time						
Ending Level						
Test End Time						
Test Period						
Level Change						
Pass/fail criteria: Must pass visual inspection. Hydrostatic: Water level drop of less than 1/8 inch; Vacuum single-walled only: Maintain at least 26 inches water column; Vacuum double-walled: maintain at least 12 inches water column.						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

*All liquids and debris must be disposed of properly.

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-4

CONTAINMENT SUMP INTEGRITY TESTING HYDROSTATIC TESTING METHOD

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This procedure is to test the leak integrity of containment sumps. See PEI/RP1200 Section 6.5 for the test method.						
Containment Sump ID						
Containment Sump Material						
Liquid and debris removed from sump?*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Visual Inspection (No cracks, loose parts or separation of the containment sump.)	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Containment Sump Depth						
Height From Bottom to Top of Highest Penetration						
Starting Water Level						
Test Start Time						
Ending Water Level						
Test End Time						
Test Period (Minimum test time: 1 hour)						
Water Level Change						
Pass/fail criteria: Must pass visual inspection. Water level drop of less than 1/8 inch.						
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

*All liquids and debris must be disposed of properly.

Tester's Name (print)_____ Tester's Signature _____

APPENDIX C-6

OVERFILL ALARM OPERATION INSPECTION

Facility Name:		Owner:		
Address:		Address:		
City, State, Zip Code:		City, State, Zip Code:		
Facility I.D. #:		Phone #:		
Testing Company:		Phone #:	Date:	

This procedure is to determine whether the high level alarm is operational and will trigger when the tank is no more than 90% full. See PEI/RP1200 Section 7.3 for the inspection procedure. This procedure is applicable to tank level monitor stems that touch the bottom of the tank when in place.

Tank Number				
Product Stored				
Tank Level Monitor Brand and Model				
1. Tank Volume, gallons				
2. Tank Diameter, inches				
3. Overfill alarm activates in the test mode at the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
4. When activated, overfill alarm can be heard or seen while delivering to the tank?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
5. After removing the probe from the tank, it has been inspected and any damaged or missing parts replaced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6. Float moves freely on the stem without binding?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
7. Moving product level float up the stem trigger alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
8. Inch level from bottom of stem when 90% alarm is triggered.				
9. Tank volume at inch level in Line 8.				
10. Calculate (Line 9 / Line 1) x 100				
11. Is Line 10 less than 90%?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
12. Fuel float level on the console agrees with the gauge stick reading?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes No
13. Overfill alarm activates at any product level above 90% tank capacity?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If any answers in Lines 3, 4, 5, 6, 7 or 11 are “No,” or Line 13 is “Yes,” the system has failed the test.				
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:				

Tester’s Name (print)_____ Tester’s Signature _____

APPENDIX C-7

AUTOMATIC TANK GAUGE OPERATION INSPECTION

Facility Name:		Owner:		
Address:		Address:		
City, State, Zip Code:		City, State, Zip Code:		
Facility I.D. #:		Phone #:		
Testing Company:		Phone #:	Date:	

This procedure is to determine whether the automatic tank guage (ATG) is operating properly. See PEI/RP1200 Section 8.2 for the inspection procedure. This procedure is applicable to tank level monitor stems that touch the bottom of the tank when in place.

Tank Number				
Product Stored				
ATG Brand and Model				
1. Tank Volume, gallons				
2. Tank Diameter, inches				
3. After removing the ATG from the tank, it has been inspected and any damaged or missing parts replaced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
4. Float moves freely on the stem without binding?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
5. Fuel float level agrees with the value programmed into the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6. Water float level agrees with the value programmed into the console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
7. Inch level from bottom of stem when 90% alarm is triggered.				
8. Inch level at which the overfill alarm activates corresponds with value programmed in the gauge?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
9. Inch level from the bottom when the water float first triggers an alarm.				
10. Inch level at which the water float alarm activates corresponds with value programmed in the gauge?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

If any answers in Lines 3, 4, 5, or 6 are “No,” the system has failed the test.

Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail

Comments:

Tester’s Name (print)_____ Tester’s Signature _____

LIQUID SENSOR FUNCTIONALITY TESTING

Facility Name:				Owner:			
Address:				Address:			
City, State, Zip Code:				City, State, Zip Code:			
Facility I.D. #:				Phone #:			
Testing Company:				Phone #:		Date:	
This procedure is to determine whether liquid sensors located in the interstitial space of UST systems are able to detect the presence of water and fuel. See PEI/RP1200 Section 8.3 for the test procedure.							
Sensor Location							
Product Stored							
Type of Sensor	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating	☐ Discriminating ☐ Non-discriminating
Test Liquid	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product	☐ Water ☐ Product
Is the ATG console clear of any active or recurring warnings or alarms regarding the leak sensor? If the sensor is in alarm and functioning, indicate why.	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Is the sensor alarm circuit operational?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Has sensor been inspected and in good operating condition?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
When placed in the test liquid, does the sensor trigger an alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
When an alarm is triggered, is the sensor properly identified on the ATG console?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Any “No” answers indicates the sensor fails the test.							
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:							

Tester’s Name (print)_____ Tester’s Signature _____

APPENDIX C-9

MECHANICAL AND ELECTRONIC LINE LEAK DETECTORS PERFORMANCE TESTS

Facility Name:			Owner:			
Address:			Address:			
City, State, Zip Code:			City, State, Zip Code:			
Facility I.D. #:			Phone #:			
Testing Company:			Phone #:		Date:	
This data sheet can be used to test mechanical line leak detectors (MLLD) and electronic line leak detectors (ELLD) with submersible turbine pump (STP) systems. See PEI/RP1200 Sections 9.1 and 9.2 for test procedures.						
Line Number						
Product Stored						
Leak Detector Manufacturer						
Leak Detector Model						
Type of Leak Detector	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD	☐ MLLD ☐ ELLD
MLLD (ALL PRESSURE MEASUREMENTS ARE MADE IN PSIG)						
STP Full Operating Pressure						
Check Valve Holding Pressure						
Line Resiliency (ml) (line bleed back volume as measured from check valve holding pressure to 0 psig)						
Step Through Time in Seconds (time the MLLD hesitates at metering pressure before going to full operating pressure as measured from 0 psig with no leak induced on the line)						
Metering Pressure (STP pressure when simulated leak rate 3 gph at 10 psig)						
Opening Time in Seconds (the time the MLLD opens to allow full pressure after simulated leak is stopped)						
Does the STP pressure remain at or below the metering pressure for at least 60 seconds when the simulated leak is induced?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Does the leak detector reset (trip) when the line pressure is bled off to zero psig?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Does the STP properly cycle on/off under normal fuel system operation conditions?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
A "No" answer to either of the above questions indicates the MLLD fails the test.						
ELLD (ALL PRESSURE MEASUREMENTS ARE MADE IN PSIG)						
STP Full Operating Pressure						
How many test cycles are observed before alarm/shutdown occurs?						
Does the simulated leak cause an alarm?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
A "No" answer to the above question indicates the ELLD fails the test.						
Does the simulated leak cause an STP shutdown?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
Test Results	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail	☐ Pass ☐ Fail
Comments:						

Tester's Name (print)_____ Tester's Signature _____

HEAT TRACE SYSTEM

Testing Procedure

HEAT TRACE SYSTEM TESTING PROCEDURE

TESTING

Procedure: Measure the heater circuit continuity and the insulation resistance between the braid and bus wires with a 250--Vdc megohmmeter (megger).

Timing: The tests should be performed after the pipe insulation has been installed and prior to installation of wall or ceiling panels, and shall be witnessed by the Construction Manager and the manufacturer or the manufacturer's representative.

Acceptable results: The heater circuit shall be continuous and megger readings shall be at least 20 megohms regardless of heater length. Circuits yielding unacceptable readings must be repaired or replaced.

Submittal of results: Submit records of the test data to the Construction Manager

3. System testing

Required Testing

To ensure the proper installation and operation of the HWAT-Plus system, three separate checks are required: insulation resistance using a megohmmeter (Megger), continuity testing using a battery, and visual inspection.

Damage to the insulating jacket of the heating cable can be detected with an insulation resistance test using a megohmmeter (Megger). Testing the heating cable at 2500 Vdc can detect damage — such as cuts, punctures, and scrapes — that create an electrical path from the conductive core to the braid. Testing at lower voltages (such as 1000 or 500 Vdc) can be useful but is not as sensitive; therefore, 2500 Vdc is recommended.

Continuity testing using a battery of 24 Vdc or less ensures that the bus wires are properly connected in a splice or tee.

Visual inspection ensures that the cable is properly attached to the pipe, the components have been installed correctly, and all required piping is traced with heating cable.

Order of Testing

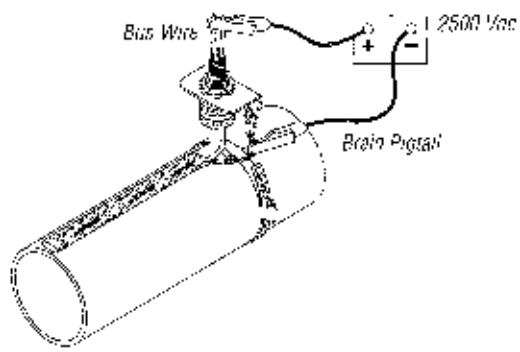
Time	Test required
When the cable is received	Megger test
After heating cable and component installation, but before thermal insulation is installed	Megger test, continuity test, visual inspection
After the insulation is installed, but before the Sheetrock is installed	Megger test, visual inspection
Before the initial start-up	Megger test

Insulation Resistance Testing (Megger Test)

To test HWAT-Plus heating cables with a Megger:

1. Connect one lead from the instrument to the HWAT-Plus heating cable braid.

2. Connect the other lead to both bus wires, as shown below.



3. Apply 2500 Vdc and measure resistance. The minimum readings should be 20 megohms regardless of heating cable length.

4. If the megger reading is less than 20 megohms, locate the fault and correct or replace damaged cable.

⚠ **WARNING: DAMAGED HEATING CABLE *MUST* BE REPLACED. DO NOT ENERGIZE DAMAGED HEATING CABLE. FAILURE TO REPLACE DAMAGED HEATING CABLE CAN CAUSE ARCING OR FIRE.**

5. Record the original values for each circuit on the Installation Testing Record or the Periodic Inspection Record.

Short-Circuit Testing and Continuity Testing

To ensure that the bus wires are properly connected in a splice or tee, the following test must be conducted before energizing the heating cable.

1. Before attaching the end seal, strip back the core 1/2 inch to allow access to the bus wires at all cable circuit ends.

2. Using a battery, apply a voltage of 24 Vdc or less to the bus wires at the beginning of the circuit. Note: This test will draw current even if there is no short-circuit.

DO NOT APPLY LINE VOLTAGE TO THE HEATER CIRCUIT. THE HEATING CABLE CAN BE PERMANENTLY DAMAGED IF A SHORT-CIRCUIT EXISTS.

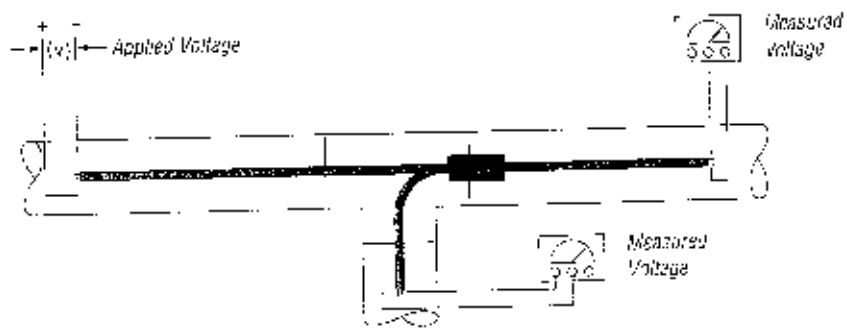
3. Check for voltage at the ends of the circuit. The voltage measured at the end of a very long circuit will be less than the applied voltage. However, if no voltage is detected, an open or short circuit is indicated.

4. If any branch of the circuit fails this test, inspect and repair as necessary any tees or splices in that section of heating cable.

5. Retest the circuit to ensure that all open and short circuits have been detected.

6. Cut a sufficient amount of cable off the ends so that the bus wires do not stick out of the core. Seal the end with an HWAT-Plus end seal.

⚠ **WARNING: EXPOSED HEATER ENDS CAN CAUSE SHOCK OR FIRE. INSTALL AN HWAT-PLUS END SEAL AFTER THE CONTINUITY TEST IS COMPLETE.**



Visual Inspection

Visually inspect the eWAT-Plus system to ensure:

- Proper installation of the system.
- No mechanical damage, such as (cuts, burns, or scrapes).
- Proper connections (intact braid connections, splices, and tees).
- Tracing of all required piping with heating cable.

⚠ **WARNING: DAMAGED HEATING CABLE *MUST* BE REPLACED. DO NOT ENERGIZE DAMAGED HEATING CABLE. FAILURE TO REPLACE DAMAGED HEATING CABLE CAN CAUSE ARCING OR FIRE.**

Troubleshooting Guide

The troubleshooting guide that follows will lead you through potential problems. If a problem persists after you follow the guide procedures, contact your Raychem representative immediately.

Symptom	Possible Causes	Corrections
Circuit breaker trips.	Circuit breaker undersized.	Reestablish what the current loads are going to be and resize the breakers.
	Circuit oversized.	Check that maximum circuit length has not been exceeded. Check to see if existing bus-wire sizing is compatible with larger-size breaker.
	Defective circuit breaker	Repair circuit breaker.
	Connections and/or splices shorting out.	Locate and repair the incorrect connections or splices.
	Physical damage to the heating cable causing a short.	Locate and remove damaged sections of heating cable. Megger per installation instructions. To locate shorting problems, follow these steps: • Visually inspect the power connections, splices, and end seals for proper installation. • Check for visual indications of damage around the valves, pumps and any area where there may have been maintenance work. • Look for crushed or damaged insulation along the pipe. If at this point you have not located the problem, start isolating one section of the heating cable from the other. (For example, cut the circuit in half and test each half to find the general area of damage, then remove the insulation to find the specific damaged area.)

Troubleshooting Guide (continued)

Symptom	Possible Causes	Corrections
Circuit breaker trips. (continued)	Bus wires connected at the end seal.	Remove end seal, disconnect the wires, and perform a current check for possible other damage.
	Excessive moisture in connection boxes or splices.	Dry out and reseal connections and splices. Megger per installation instructions.
	Nick or cut in heating cable or power feed wire with moisture present.	Locate and replace damaged power feed wire or heating cable. Verify that system passes megger test.
	Start up at too low a temperature.	Raise building temperature to minimum 60°F or run hot water through pipes.

⚠ **WARNINGS:**

⚠ **1. TO PREVENT SHOCK OR PERSONAL INJURY, TURN OFF POWER AT THE CIRCUIT BREAKER BEFORE WORKING ON THE HEATING CABLE OR PIPING.**

⚠ **2. DAMAGED HEATING CABLE MUST BE REPLACED. DO NOT ENERGIZE DAMAGED HEATING CABLE. FAILURE TO REPLACE DAMAGED HEATING CABLE CAN CAUSE ARCING OR FIRE.**

Symptom	Possible Causes	Corrections
Pipe temperatures are below design values	Water heater thermostat or mixing valve set incorrectly	Reset the thermostat or mixing valve.
	Water heater thermostat or heating element failure.	Check thermostat and heating element.
	Water heater not on.	Turn on water heater.
	Low- or no-input voltage.	Repair electrical supply lines and equipment.
	Splices or tees are not connected. Heating cable has been severed.	Check routing and length of heating cable (use "as builts"). Connect the splices or tees, locate and replace the damaged heating cable, then recheck the power.
	Improper connection causing a high-resistance connection.	Reattach with the correct procedure.
	Heating cable exposed to excessive moisture.	Replace the heating cable.
	Heating cable exposed to excessive temperatures.	
	Insulation is wet.	Remove wet insulation and replace it with dry insulation; repair leaks in pipe.
	Insulation or ambient temperature not per specification.	Correct to requirements shown on page 11.
	Heating cable not insulated per plans; cable left off some pipes.	Check plans and verify that cable is installed on all pipes and insulated correctly.
Pipe temperatures are above design value.	Voltage to circuits is too high.	Power circuits at 208 Vac.
	Ambient temperature is too high.	Adjust building temperature within range shown on page 11.
	Pipe insulation is not as specified.	Install correct insulation per Insulation Schedule on page 12.

4. System operation

System Start-up

The start-up of an HWAT-Plus system is simple: once the heating cable has passed all megger and continuity tests, simply turn on the circuit breakers and wait approximately four hours for the water to warm up. For a faster start-up you can turn on the water heater and open the fixture at the end of the piping run until the water feels warm.

If your piping system is closed, such as by pressure-reducing valves or isolation valves, you must provide some method of pressure relief to allow for thermal expansion of the water during heat-up as specified in ANSI Z21.22.

If the circuit breakers trip, or the water does not warm up, refer to the Trouble shooting Guide on page 15.

Normal Operation

An HWAT-Plus system in operation will provide hot water without the noise, wide variation in temperature, or high energy costs associated with recirculation systems, and will operate trouble-free for years to come.

BE SURE THAT THE WATER HEATER OR MIXING VALVE IS SET AT THE TEMPERATURE NEEDED AT THE FIXTURE: 105°F (40°C), 115°F (45°C), 125°F (50°C), OR 140°F (60°C). THE WATER TEMPERATURE SHOULD ALWAYS REMAIN WITHIN 15°F OF THE CABLE TEMPERATURE. EXCEEDING THIS TEMPERATURE CAN SHORTEN THE HWAT-PLUS HEATING CABLE LIFE.

⚠ **WARNING: TO PREVENT SHOCK OR PERSONAL INJURY, TURN OFF THE POWER AT THE CIRCUIT BREAKER BEFORE TESTING OR WORKING ON THE HEATING CABLE OR PIPING.**

Periodic Inspection

The HWAT-Plus system has no moving parts and therefore requires no maintenance to keep the system operating. However, regular inspection and testing according to the following guidelines is recommended to ensure that the system has not been damaged:

- The system should be meggered annually. See Section 3, "System Testing", for the proper meggering procedure. This Megger check may be done at the circuit breaker panel or at the heating cable power connection. Record the readings on the chart at the end of this section.
- Where possible, visually inspect the pipe insulation and heating cable periodically to make sure that no physical damage has occurred.
- Periodically check the thermostat on the water heater or mixing valve. The HWAT-Plus system can be damaged by temperatures more than 15°F above the cable temperature rating. An HWAT-Plus system does not require overheating at the water heater in order to supply water at the correct temperature. Therefore, the water coming from the mechanical room should be at the desired temperature.
- The electrical equipment, such as circuit breakers, should be checked periodically. The ground fault feature should also be tested monthly. Record the results of this test on the chart at the end of this section.

Installation Testing Record

Building name: _____

Electrical contractor: _____

Mechanical contractor: _____

Completion date: _____

Test procedure	Initials & date	HWAT-Plus heating cable circuit number 1	2	3	4	5	6	7
Before splices & tees								
Megger (value)								
Before insulation								
Megger (value)								
Short circuit and continuity check								
Visual inspection								
Before Sheetrock								
Megger (value)								
Visual inspection								
Before start-up								
Megger (value)								

HWAT-Plus
Circuit Schedule

Building name:

Electrical contractor:

Mechanical contractor:

Completion date:

Circuit number	Location	Quantity and location of tees	Quantity and location of splices	Circuit breaker size	Circuit length

SECTION 22 0501 - COMMON PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

B. Related Sections: Refer to "Electrical Requirements for Plumbing Equipment" Division 26 for basic electrical requirements, for all Mechanical equipment in Division 23. Special and specific electrical requirements are specified within each respective equipment specification section.

1.2 SCOPE OF WORK - GENERAL

A. This section specifies the basic requirements for plumbing installations and includes requirements common to Section 220000. It expands and supplements the requirements specified in sections of Division 01 General Requirements.

B. The work covered by the Plumbing Sections of the Specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of all mechanical work required in the Contract Drawings.

C. It is the intent of the Contract Documents to provide an installation that is complete and operable in every respect. In the event that additional details or special construction is required for work indicated or specified under this section of work or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

D. The Contractor shall review all Contract Drawings (Plumbing and HVAC) and Specifications and include in his bid all work specifically as being performed in the Plumbing section. The Contractor shall be responsible for all work performed by his subcontractors.

1.3 DEFINITIONS

A. "Provide" shall mean "furnish and install complete and ready for intended use."

B. "Indicated" shall mean "indicated on drawings" and/or the intent for a complete and operable system.

C. "Concealed" shall mean "hidden from sight as in trenches, chases, furred spaces or hung ceilings.

D. "Exposed" shall mean "not concealed", as defined above.

E. "Noted" shall mean "noted on Plumbing and HVAC drawings or in specifications".

F. "Contractor" also referred to as "Plumbing Contractor" or "the Contractor", shall mean "the Plumbing Contractor".

1.4 CODES AND STANDARDS

A. All plumbing work shall be installed in strict accordance with the most current edition of the International Building Code (IBC) or International Plumbing Code, International Mechanical Code (IMC), Uniform Plumbing Code (UPC), National Fire Protection Association (NFPA), International Fire Code (IFC), National Electrical Code (NEC), Energy Code IECC and ASHRAE-90.1, and all applicable state and local codes, laws and ordinances that relate tothe work to be accomplished.

1.5 PERMITS AND FEES

A. The Contractor shall obtain and pay for all required permits and fees necessary tofully complete all work included in the Contract Drawings and Specifications.

1.6 CONSTRUCTION OBSERVATIONS:

A. During the course of construction of this project, the engineer shall visit the project site periodically on an as-needed basis. The construction observation intervals may vary depending on the progress and/or stage of construction and whether sewer, vents, water, natural gas, air, Domestic cold and hot water for drains, and overflows, condensate piping, etc., is being placed below grade and/or concealed, surface mounted items, setting of equipment, equipment connections, etc. However, written field questions are encouraged and welcomed throughout the course of construction and shall be answered promptly in writing, to keep the project construction on schedule. The project foreman should have the building plans, construction schedules, etc., affixed in mind, so the plumbing systems defined in the construction documents are to be assembled, along with the setting of equipment, of parts and pieces, related to the project are anticipated, to prevent delays or emergencies.

B. The engineer shall make one (1) final inspection. The contractor shall notify the engineer that the installation is complete, i.e., the systems are operating and have been tested and balanced, and everything is complete and operational, all equipment connections have been made and the owner’s representatives have been trained. At this time the engineer, the contractor, and the owner’s representative shall schedule a time to walk the project for evaluation, and record in writing the items found to be incomplete.

C. On extra visits, the contractor shall report to the engineer that all systems are complete, and the project is ready for the owner’s acceptance.

1.7 INTENT AND INTERPRETATION

A. The Drawings and Specifications are intended to supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.

B. The drawings are partly diagrammatic and do not necessarily show the exact location of all new piping and existing utilities, unless specifically dimensioned.

C. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining quantities or lineal runs of piping.

D. The location of all piping shall be checked to determine that it clears all openings and structural members; that it may be properly concealed; and that it clears cabinets, lights and equipment having fixed locations.

E. Plumbing drawings shall serve as the working drawings for this portion of the work but the Contractor shall refer to the Architectural, Structural, HVAC, and Electrical drawings for additional detail affecting the installation of his work. Architectural drawings shall take precedence over the Plumbing drawings if any dimensional discrepancies exist.

F. The approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the approval of the Architect, who reserves the right to make any reasonable changes in the locations indicated without additional cost.

G. The contractor shall not make a change in a system, system layout, and/or equipment, except when he receives written approval or drawing with the signature of the engineer.

1.8 SUBMITTAL OF EQUIPMENT FOR APPROVAL

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01General Requirements for submittal definitions, requirements and procedures.

B. SHOP DRAWINGS AND PRODUCT DATA OF EQUIPMENT BEING INSTALLED IN THE PROJECT: After the contract is awarded, but prior to manufacture or installation ofany equipment, the contractor shall assemble and submit Shop Drawings, parts lists, Brochures, etc., for the materials and equipment requiring approval for each section of this specification. A brief description of submittal conditions is given below. Refer to identified sections for detailed submittal requirements.

C. Confirming and approving substitute equipment for the project.

1. Confirm that the substitute equipment is approved for installation before entering it into the base bid. It must be defined as to name, catalog number or both in a published addendum. **If not approved, do not enter in the base bid**.
2. Each unit shall state the name of the equipment manufacturer (name, address, phone, email, etc.) catalog number, size, physical dimensions and weight, energy characteristics (electrical and/or fuel), operating characteristics, materials from which constructed, any special conditions that may apply to the construction of the unit, etc.
3. The equipment must explain and define in detail the components that make-up the unit, so the owner and engineer can determine, define the replaceable parts during the life of the unit.
4. Complete operating instruction, normal maintenance recommendations, start-up procedures, etc.
5. In general, the contractor shall acquaint himself with the equipment to confirm that it can be installed as shown on the plans and from his experience perform the indicated function in the system where installed.

6. In the course of reviewing the shop drawings, **the Contractor shall confirm the energy usage** (gas, power, air, water, drains, physical size, weight etc.) and determine if these services are available at the equipment characteristics. Namely: confirm voltage, phase, etc., with the project's electrical characteristics. Availability of fuels with the serving utility, also drains, water (hot and cold) pipe sizes, etc., or if there is discrepancies in the services. If the indicated equipment services are not available, inform the engineer by phone and in writing, also note on the shop drawing. This cooperative effort will correct a problem before the equipment arrives at the job site.
   a. The shop drawings shall also indicate the scheduled delivery dates theequipment will be at the site.
   b. If the contractor foresees any problems with equipment size, weight, delivery, etc., it shall be noted in writing, attached to the shop drawings.

1.9 RECORD DOCUMENTS

A. Contractor shall record differences between plumbing systems as installed and those indicated in Contract Documents on a set of prints of plumbing drawings to be furnished by Architect. Return these prints to Architect at completion of project. Notations made on drawings shall be neat and legible. Comply with Division 01 General Requirements.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Contractor shall prepare and submit Operation and Maintenance Manuals for mechanical systems provided under this Contract. Comply with Division 1 requirements for procedures and requirements for preparation and submittal of manuals.

B. Manual binder shall have permanent lettering of a contrasting color. Information to be included on the binder is as follows:

C. The front cover shall be lettered as follows:

PLUMBING OPERATION AND MAINTENANCE MANUAL
(PROJECT NAME)
(CITY AND STATE) YEAR)

OWNER:	*(NAME)*
ARCHITECT:	*(NAME)*
PLUMBING ENGINEER:	(*NAME)*
GENERAL CONTRACTOR:	*(NAME)*
PLUMBING CONTRACTOR:	*(NAME)*

The spine shall be lettered as follows:

PLUMBING O & M MANUAL (*Year)*
(Project Name)

D. Provide a master index at beginning of Manual showing items included. Use plastic tab indexes for sections of Manual.

E. Cover section shall consist of name, address, and phone number of Project Architect, General Contractor, Mechanical Engineer, Mechanical Contractor and all Mechanical Sub-Contractors.

F. Provide a separate section for each section of the specifications. Provide index for each section listing equipment included. Include all items specified in Sections 220529 through 226313. Provide a list of each type of equipment supplied with the local supplier's name, address and phone number.

G. Include descriptive literature (manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined. Data sheets shall be original. Copies are not acceptable.

H. One (1) copy of the manual shall be submitted for review and approval by the Engineer. After approval, submit three (3) copies of manual to the Owner for approval unless otherwise directed by Division 1 requirements. Information to be included in manual:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping shut-down, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Schematic control diagrams (as built status) for each automatic control system. Mark correct operating setting for each control instrument on these diagrams. A second complete set of control diagrams encased in clear plastic laminate shall be furnished.
6. Valve schedule indicating the valve symbol (tag number), valve location by room number and description, valve purpose and system served, and valve size. Provide one corresponding set of full-size mechanical prints (as-builts status) showing these valve locations for cross-reference. A second complete set of valve schedules (8-1/2 in. x 11 in.) encased in clear plastic laminate and fitted in an aluminum holding frame shall be furnished to the Owner.
7. Testing, Adjusting and Balancing Report.
8. Test records and certifications.
9. Instruction period checklist.
10. Warranty information.

1.11 OPERATION AND MAINTENANCE INSTRUCTION AND TRAINING

A. The Contractor shall instruct the Owner's Representative(s) in the Operation and Maintenance procedures described in the Operation and Maintenance Manual. Comply with Division 1 requirements.

B. Individuals present shall include Contractors, Subcontractors, and equipment factory representatives. These individuals shall assist in instruction and start-up.

C. Minimum instruction time shall be eight (8) hours unless otherwise specifically noted.

D. All Plumbing systems shall be properly functioning prior to instruction period.

E. Contractor shall prepare a checklist of all equipment and systems requiring instruction and maintenance for verification by the Owner's Representative of satisfactory start-up and instruction. A copy of this checklist shall be included in the Operation and Maintenance Manual.

1.12 GUARANTEE

A. Contractor shall guarantee the satisfactory operation of all material and equipment installed under section 220000 and shall repair or replace to the satisfaction of the Owner or Architect, any defective materials, equipment, or workmanship which may show itself within one year from the date of acceptance.

1.13 CLEANING

A. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish.

B. At completion of the job, the Contractor shall remove all tools, scaffolding, and surplus materials.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. All materials, in general, shall conform to the requirements of all agencies orpublications specified and described in Division 01 of the Contract Specifications.

B. Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

2.2 SUBSTITUTIONS AND APPROVAL OF PRODUCT OPTIONS

A. Substitute equipment is encouraged if it is truly an equal to the specified items

1. The items and/or equipment specified in the contract documents are standard manufacturers items found in suppliers' catalogs, except it be indicated as special. The designer has taken time and effort to analyze, evaluate and prove to himself that the specified units will perform the function needed, wherein it is placed. This means the responsibility for the function of the specified equipment rests with the designer, who knows and understands what is to be accomplished.

2. If a **supplier** and/or the **contractor** desire to substitute equipment in place of a specified item, he may do so, but he takes upon himself or herself the **full responsibility** that the substituted equipment will equal all of the performing characteristics, functions, etc., and/or exceed the performance of the specified item. The substitute equipment shall be of such a physical size and weight that it will mount in the designated location without alterations to the building and the structure will carry the load. If for any reason the substituted equipment requires alterations or modification, in any form to the building and/or the structure, the costs shall be paid by the contractor and/or those requesting the substitutions.

3. Those interested in requesting a substitution shall submit a substitution request. The **substitution request will be considered if it is at the office of the Engineer eight (8) working days prior to the day of bidding. The request shall include the following:**

a. A statement certifying that the equipment proposed is equal to that specified; that it has the same mechanical operating characteristics, compatible dimensions, weight, electrical characteristics and meets the function and intent of the equipment named in the contract documents.

b. The specification and catalog numbers of the substituted equipment.

c. A pictorial and specification brochure.

4. Because of the short bidding period, (from issuance of drawing to bid date), between the substitution request and the bid date, the designer does not have adequate time to make a full evaluation of substitute equipment. Therefore, **those requesting the substitution** must accept **full responsibility** for the items being submitted for substitution (operating characteristics, physical size, weight, output, not increase the load, etc.). If at any time during the course of construction, **even up into the final completion**, if the designer finds the equipment does not meet the design criteria, comply with the performance, etc., **those requesting the substitution and the contractor have the responsibility to remove the substituted equipment and install the specified item at their expense.** There shall be no cost assessed to the owner and/or the designer and **the replacement will not delay the completion of the project.**

B. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents, nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer, who will issue interpretation and/or additional instructions to Bidders before the project is bid.

C. Any conflict arising from the use of **substituted equipment shall be the responsibility of the contractor,** who shall bear all costs required to make the equipment comply with the intent of the contract documents.

D. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

E. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued. This substitution may be made by a change order.

F. Substitute equipment shall not be bid except it is formally issued on a **Project Addendum**.

PART 3 - EXECUTION

3.1 COORDINATION AND WORKMANSHIP

A. The Contractor shall at all times cooperate with other trades on the job to avoid friction and delay to the progress of work. All points in dispute shall be referred to the Architect.

3.2 SUPERVISION

A. This Contractor shall have in charge of the work at all times a thoroughly competent superintendent. Comply with Division 01 requirements.

3.3 WORKMANSHIP

A. The work under the plumbing contract shall be performed by Journeyman workers skilled in the particular trade and include all work necessary to properly complete the installation in a professional manner so as to present a neat and finished appearance.

3.4 EXAMINATION OF SITE

A. The Contractor shall visit the site of the proposed work and become familiar with the conditions affecting the work. Contractor shall verify all measurements at the building before beginning work.

3.5 SITE UTILITY SERVICES

A. Where applicable, the Contractor shall make connections to existing permanent cold-water service immediately so as to provide the use of this service by other trades. Comply with Division 01 and 02 requirements.

3.6 LAYING OUT WORK

A. Locations of all equipment shown on the drawings, is approximate unless dimensioned. Exact locations of such items shall be determined by the Architect s representative and/or secured from special details and drawings. Verify the physical dimensions of each item of plumbing equipment to fit the available space and promptly notify the Architect/Engineer prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor s responsibility.

B. The contractor **shall hand deliver to the general contractor** a written statement and/or a manufacturer’s brochure on the equipment being installed at each location. The information shall give the dimensions and weight (loads) of each unit being installed. The general contractor shall forward a copy of this information to the structural engineer and obtain from him confirmation that the building structure will accommodate the loads. If there be any problem the questioning party shall notify the mechanical engineer by phone and in writing.

3.7 CONTRACTOR COORDINATION

A. In the course of installing the systems defined in the contract documents, the contractor shall closely follow the plans, details and specifications (contract documents). The system design has been a careful and laborious undertaking, with the intent purpose of producing a system and/or systems that will serve the owner well with a minimum of maintenance. Thence, the contractor shall adhere as closely as possible to the plans, details and specifications for each system. Questions and suggestions are encouraged as the project is being assembled. If for any reason, the contractor feels to deviate from the defined information, and finds a way, to improve the system, to make the system more easily assembled, make it operate more efficiently, etc., the contractor shall suggest the change to the engineer. Systems are designed to perform a specific function; the most minute change in assembly may change the function. If the engineer agrees with the change he will authorize the contractor to proceed. Contractor cooperation and coordination is appreciated. If the contractor proceeds on construction without the designer's authorization, it shall be reworked, in accordance to plans and specifications, which work shall be at the contractor's expense.

B. The contractor shall coordinate his construction. These systems, location of equipment, connections of services, etc. with the architectural, HVAC sector 230000, electrical260000 documents throughout the course of construction. If problems are unsolvable contact the design engineer.

3.8 CUTTING AND PATCHING

A. All cutting and patching of new or existing construction required for installation of Plumbing systems and equipment specified in Section 220000 shall be the responsibility of the Plumbing Contractor unless otherwise noted. Comply with Division 01 for general requirements for cutting and patching.

B. All cutting shall be performed with masonry saws, core drills or similar equipment to provide neat and uniform openings.

C. All patching shall match adjacent surfaces in materials and finish. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of plumbing installations.

E. No additional compensation will be authorized for cutting and patching work thatis necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.

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G. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.9 EXCAVATION AND BACKFILL

A. Contractor shall provide all necessary excavation, shoring, and backfilling required for proper installation of plumbing work inside and outside the building. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to ½ the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site and shall be disposed of in designated areas approved for surplus material storage. Grading shall be done as necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained.

B. Trenches shall be excavated to depth indicated or required to establish indicated slope and invert elevations and to support bottom of piping or conduit on undisturbed soil. Trenches shall be of uniform width, sufficient to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.

C. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing. Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with materials described below for bedding.

D. Excavation for manholes, catch basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

E. Bedding material shall be clean, sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 422.

U.S. Standard	Percent Passing Sieve Size
1-Inch	100
No. 4	25-80
No. 200	0-10

F. Bedding material shall be placed to a depth of 6 inches (6") over the top of piping. The bedding shall be brought up evenly on both sides of the pipe for the full length of the pipe.

G. Backfill for the remainder of the trench shall be satisfactory soil materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.

H. Backfill soil materials shall be free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

I. Backfill to the required grade shall be placed in lifts not exceeding 6 inches loose thickness for compaction with hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines otherwise specified. Each layer shall be compacted to density 105% of the adjacent soil density or as stated in the soil compaction section of these documents.

J. No underground lines shall be covered until the installation has been approved by the inspector having jurisdiction and the Owner's Representative.

K. Provide 4-inch-thick concrete base slab support for piping less than 2'-6" below surface of roadways. After installation and testing of piping, provide minimum 4-inch-thick encasements (sides and top) of concrete prior to backfilling or placement of roadway subbase.

L. Bracing and shoring shall be provided where depth of excavation or character of ground render it necessary for personnel protection. Shoring shall be constructed of heavy timber planking with timber supports and shall conform with local and state safety laws and regulations.

M. Removal of bracing and shoring materials shall be done before backfilling except where necessary to insure against caving; in which case, it shall be withdrawn while backfilling is being done.

N. Provide barricades around all excavation. Barricades to be securely constructed.

O. The Contractor shall exercise extreme care while excavating in the area of utilities, carefully check for location of all possible utilities, whether shown on the drawings or not, and establish the location of all cutoff valves for ready shut-off of service in case of emergency. The Contractor shall be completely responsible for all damage to any utilities caused in excavating as well as damage to personnel and property caused by said damaged utilities whether shown on the drawings or not.

3.10 REPLACEMENT OF PAVING AND CONCRETE

A. All existing or new sidewalks, concrete paving, curbs, or asphalt paving removed or damaged by this Contractor during the period of the installation or as a result thereof, shall be replaced with like material in a manner as directed by and to the satisfaction of the Owner's Representative. Comply with Division 02 General Requirements.

3.11 OPENINGS IN PIPES

A. All temporary openings in pipes shall be capped or sealed during construction. Caps shall be removed for final connections.

3.12 PROTECTION OF MATERIALS AND EQUIPMENT

A. Contractor shall be held responsible for any and all materials and equipment to be installed under this contract and will be required to make good at his own cost any injury or damage which materials or equipment may sustain from many source or cause whatsoever before final acceptance. Comply with Division 1 requirements.

3.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials at the site, unless off-site storage is authorized inwriting. Protect stored equipment and materials from damage.

C. Coordinate deliveries of plumbing materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.14 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all partsthat require replacement or servicing.

B. Access doors or hatches required for servicing of mechanical equipment shall be furnished and installed as specified in the other Sections of the Specifications.

3.15 PAINTING

A. The contractor shall paint all-natural gas lines exposed to the elements with 2 coats, one coat of primer and one coat of paint, yellow oil base enamel and likewise all other piping as indicated.

B. Contractor shall touch-up scratched, or damaged factory finishes of Plumbing equipment. Comply with Division 01 requirements.

C. Unless otherwise noted, all other painting of Plumbing related items shall be according to Section 09900 "PAINTING".

3.16 LUBRICATION

A. Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. Comply with Division 01 requirements.

3.17 FINAL CLEANING

A. Refer to Division 1 for general requirements for final cleaning.

B. At time of final cleanup, all fixtures and equipment shall be thoroughly cleaned and leftin condition for use. All stickers, tags, shipping labels, and Manufacturers labels shall be removed.

3.18 FIRE PENETRATION SEALS

A. All penetrations through fire rated floors and walls shall be sealed to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor to wall into which it is installed so that the original fire rating of the floor or wall is maintained.

B. The sealant shall remain soft and pliable to allow for the removal and/or addition of piping without the necessity of drilling holes. It shall adhere to itself to allow any and all repairs to be made with the same material. It shall permit the vibration, expansion and/or contraction of piping and ducts going through the penetration without the seal cracking or crumbling.

C. When damming materials are to be left in place after the seal is complete, all such materials shall be non-flammable.

D. When sealant is injected into a penetration, the foam shall expand to surround all items within the penetration and maintain pressure against the walls of the penetration. Excess foam shall be removed. The foam shall cure within five minutes and be fire resistant at that time. No heat shall be required to further expand the foam to block the passage of fire and smoke or water.

E. All wall or floor penetration openings shall be as small as possible.

F. The foam sealant shall meet all of the fire test and hose stream test requirements of ASTM E119-73 and shall be UL classified as a Wall Opening Protective Device. the sealant shall be CHASE-FOAM, CTC PR-855 Fire Resistant Foam Sealant from Chase Technology Corporation, Huntington Station, New York 11746 or 3M Brand Fire Barrier caulk CP25,putty 303, wrap/strip FS 195 or sheet CS 195 from 3M Products Divisions, 224-4N 3M Center, St. Paul, MN 55144-1000.

3.19 TESTING, ADJUSTING, AND BALANCING

A. The plumbing systems shall be pressure tested in strict accordance with local and state codes by Journeyman with five plumber’s years’ experience in pressure testing. The report shall be stamped by a licensed certified plumber. The Balancing water flows in and to all equipment shall be instruments for making tests and performing work. The Plumbing Contractor shall include in his base bid all costs for tests and Balancing.

B. Testing of piping systems shall not be made until the code conditions are satisfied.

C. All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. The Mechanical Engineer has the right to request instrument recalibration, or the use of other instruments, where accuracy of readings is questionable.

D. Furnish in the report a written guarantee to be effective for one year from the date of acceptance, to make any and all adjustments required to maintain comfort in all rooms and areas.

E. Reports

1. Upon completion of testing, adjusting and balancing of the water systems, prepare a complete and legible draft report. Submit two (2) copies of the draft report to the Plumbing Design Engineer for review.

(1) Upon verification and approval of the draft reports, prepare final reports. Four (4) typewritten, organized and formatted copies of the final report are required. Furnish one (l) Copy to the Mechanical Design Engineer for his record, and the remaining three (3) copies are to be included in the Owner s Operation and Maintenance Manuals.

END OF SECTION 22 0501

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions section 01 and Section 220501 apply to this section.

B. Types of pipe and fittings as specified under each section.

1.2 SUMMARY

A. Included but not limited to

1. All domestic water lines (hot, cold, return, service, etc.) being installed under the contract documents. Gas piping soil, waste and vent condensate.

1.3 QUALITY INSURANCE

A. Rigid pipe hangers shall carry 5 times the load. See details on the plans.

1.4 PRODUCTS

A. Adjustable, malleable iron device type of a diameter adequate to support the pipe size see schedules below.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers, Rods, and Inserts:

1. Black or Iron Galvanized or UL approved for service intended.
2. Hangers and accessories shall be Grinnell numbers specified or equals by B-Line.
   a. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on drawings. Hangers shall have double nuts.
   b. Support insulated pipes with clevis hanger equal to Grinnell Fig 260 or roller assembly equal to Grinnell Fig 171 with an insulation protection shield equal to Grinnell Fig 167. Gauge and length of shield shall be according to Grinnell design data.
   c. Support uninsulated copper pipe from Grinnell Fig CT-65 copper plated hangers and clevis hanger equal to CT-65 is Clevis Hanger, CT-97 Adjustable Ring.

3. Support rods for single pipe.

Rod Diameter	Pipe Size
3/8inch	2 inches and smaller
1/2inch	2-1/2 to 3-1/2 inches
5/8inch	4 to 5 inches
3/4inch	6 inches
7/8inch	8 to 12 inches

4. Support rods for multiple pipe supported on steel angle trapeze hangers:

Rods		Number of Pipes Carried, of Sizes Listed						
Number	Diameter	2 Inch	2-1/2 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	2	--	--	--	--	--	--
2	½ Inch	3	3	2	--	--	--	--
2	5/8 Inch	6	4	3	2	--	--	--
2	3/4 Inch	9	7	5	3	2	2	--
2	7/8 Inch	12	9	7	5	3	2	2

5. Size trapeze angles so bending stress is less than 10,000 psi.
6. Riser clamps for vertical piping: Grinnell Figure 261.
7. Concrete Inserts
   a. Grinnell Figure 282
   b. Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
   c. Continuous inserts shall be Unistrut P-3200 series.

8. Steel bracket: Unistrut P1000 with clamp nut, 6 inch length minimum.

2.2 MANUFACTURERS

A. Contact Information

1. B-Line Systems, Highland, IL www.blind.com
2. EPCO Products Inc, Fort Wayne, IN www.epcoproducts.com
3. Globe Pipe Hanger Products Inc, Cleveland, OH www.globepipehanger.com
4. Grinnell Corp, Lansdale, PA www.grinnell.com
5. Michigan Hanger Company, Niles, OH (800) 333-0852 or (330) 544-4700.
6. Superstrut by Thomas & Betts, Memphis, TN www.tnb.com

7. Victaulic Company of America, Easton, PA or Victaulic Company of Canada, Rexdale, ON www.victaulic.com
8. Watts Regulator Co, North Andover, MA www.wattsreg.com

END OF SECTION 220529

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SECTION 22 0533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish, install and test domestic hot water temperature maintenance system on domestic hot water system.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. All heat trace shall be domestic (USA) manufactured.

2.2 MATERIAL

A. Electric self-regulating heating cables and components for maintaining the water temperature of the domestic hot water system as indicated on the drawings. Raychem Hwat-Plus System.

B. System cables and components shall be U.L. Listed for domestic hot water temperature maintenance.

C. System shall maintain a nominal minimum temperature of 105"F at 208-volt.

D. Submittals: Manufacturers catalog cuts showing materials and performance data.

E. Acceptable Manufacturers: Easy Heat, Nelson.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The system shall be installed according to the drawings and meets all code requirements and the manufacturer's instructions. The installer shall be responsible for providing a functional system, installed in accordance with applicable national and local code requirements. Each circuit shall be protected with a 30-mA ground-fault protection device.

3.2 TESTING

A. Procedure: Measure the heater circuit continuity and the installation resistance between the braid and bus wires with a 2500-Vdc megohm meter (megger).

B. Ground Timing: The tests should be performed after the pipe insulation has been installed and prior to installation of wall or ceiling panels and shall be witnessed by the Construction Manager and the manufacturer's representative.

C. Acceptable Results: The heater circuit shall be continuous and megger readings shall be at least 20 megohms regardless of heater length. Circuits yielding unacceptable readings must be repaired or replaced.

D. Submittal of Results: Submit records of the test data to the Construction Manager.

END OF SECTION 22 0533

SECTION 22 0548 - VIBRATION SUPPORTS AND SEISMIC RESTRAINTS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions Division 01 and Section 220501 apply to this section.

B. Section 033000 Cast-In-Place Concrete

C. Furnishing and installing of seismic restraint and vibration isolation systems is by installer of equipment requiring such systems. Manufacturers of equipment specified for seismic restraint equipment requiring such systems. Manufacturers of equipment dimensions, dimensioned anchor points, operating weight, and center of gravity dimension.

1.2 SUMMARY

A. Includes but not limited to

1. Quality of and requirements for anchorage and seismic restraint systems and vibration isolation systems for plumbing piping and equipment.

1.3 REFERENCES

A. American Society for Testing and Materials

1. ASTM A 615-04b, ‘Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement’.

B. Sheet Metal and Air Conditioning Contractors National Association/American National Standards Institute.

1. SMACNA/ANSI 001-2000, ‘Seismic Restraint Manual: Guidelines for Mechanical Systems’.

1.4 SUBMITTALS

A. Product Data

1. Restraint system and anchorage method to be used for each piece of equipment.
2. Seismic restraints and calculations for all flexible mounted equipment.
3. Vibration isolators and flexible couplings.
4. Clearly outlined procedures for installing and adjusting isolators, seismic bracing anchors, and snubbers.

B. Shop Drawings

1. Show size, hanger length, and location of seismic restraints for piping and ductwork.

2. Show details for each isolator and seismic brace with snubbers proposed for specified equipment.
3. Show details for proposed structural steel frames and rails and for anchors to be used in conjunction with isolation of equipment.
4. Show locations of piping and ductwork restraints on installation and fabrication floor plans (not bid set of documents of floor plans), noting size and type of restraint to be used.
5. Show details of supports, hangers, anchorage, and bracing for isolated equipment as designed or proposed by professional engineer employed by a Restraint Manufacturer and qualified with seismic experience in bracing for mechanical equipment. Shop drawings submitted for seismic bracing and anchors shall bear engineer's signed professional seal.
6. Include anchor bolt calculations, signed and stamped by registered engineer, showing adequacy of bolt sizing and type.
    a. Calculations shall include anchor embedment, minimum edge distance and minimum center distance.
    b. Design lateral forces shall be distributed in proportion to mass distribution of equipment.
    c. Furnish calculations for anchors on restraint devices, cable, isolators, and on rigidly mounted equipment.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: System design and installation shall meet seismic requirements as defined in 2009 Edition of International Building Code, Section 1621 and applicable state and local codes in accordance with the site's Seismic Zone and with the minimum restraint capability of .5 g. Explicit requirements and details can be found in referenced SMACNA Manual.

B. Seismic Requirements: Plumbing equipment and piping shall be braced, snubbed, or supported to withstand seismic disturbances and remain operational.

C. Vibration Isolation Requirements: Isolate equipment from structure by means of resilient vibration and noise isolators.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Isolation and Seismic Equipment:

1. Piping: Restrain piping in accordance with Figures 4.11 to 4.19 in SMACNA Manual.
2. Equipment with Fixed Anchor or Support:
    a. Restraint designed according to Sections 1621 and 1622 of International Building Code.
    b. Horizontal force factor for elements of structures:
        1) In addition, vertical force restraint requirement shall be computed at ½ value of horizontal forces.
        2) Restrain equipment not anchored directly to floors by cable system designed and furnished by Restraint Manufacturer.

B. Vibration Isolation Requirements:

1. Design and install isolation equipment, hangers, connections, and other isolating devices to prevent transmission of vibration to structure from equipment and associated piping.
2. For floor-mounted equipment, use recommendations of ASHRE 2003 Table 45.
3. For roofs and floors constructed with open web joints, thin long span slabs, wooden construction and unusual light weight construction, evaluate equipment weighing more than 300 pounds to determine additional deflection of structure caused by equipment weight. Isolator deflection shall be 15 times additional deflection or deflection shown in Table 45, whichever is greater.
4. Under-Equipment Spring Isolators:
   a. Equal to Mason SSLFH earthquake motion restrained spring mounts with freestanding stable steel springs, leveling bolts, corrosion resistant finish, motion limiting design, uplift restraining bolts, and 1/4-inch ribbed neoprene noise stop pad.
   b. Isolators shall accept force in any direction up to 1.0g without failure and shall limit movement to 3/4 inch in any direction.
   c. Springs shall have 50 percent overload capacity.
   d. Size as required to achieve specified static deflection.
   e. Outer diameter of spring proper shall not be less than 0.8 of spring height when in loaded position.

5. Overhead Support Spring and Rubber Hangers:
   a. Combination spring and neoprene hangers.
   b. Hanger bracket shall have 500 percent overload capability and shall allow up to 15-degree hanger rod misalignment without short-circuiting.
   c. Springs shall have 50 percent overload capacity.
   d. Provide seismic bracing as required.

6. Isolate piping in mechanical equipment rooms and piping three supports away or 50 feet from other mechanical equipment, whichever is greater, form structure by means of vibration and noise isolators.
   a. Isolate suspended piping with combination spring and fiberglass hangers in supporting rods.
   b. Support floor-mounted piping directly on spring mounts.

7. Isolate vertical pipe risers from structure using vibration and noise isolating expansion hangers having minimum rated deflection of four times anticipated pipe movement. Enclose in housing for fail-safe equipment.
8. Incorporate flexible connectors in piping adjacent to reciprocating equipment.
9. Elastomeric Isolator: Neoprene or high-quality synthetic rubber with anti-ozone and antioxidant additives.
10. Nuts, Bolts, and Washers: Electroplated zinc.
11. Isolators Exposed to Weather: Cadmium plated and neoprene coated springs.

C. Seismic restraint equipment and resilient isolation devices shall be designed and furnished by single Manufacturer.

D. Type One Acceptable Manufacturers:

1. Amber/Booth Company, Houston, TX www.amberbooth.com.
2. Mason Industries Inc, Hauppauge, NY www.mason-ind.com.

3. Vibration Mountings and Control Inc, Bloomington, NJ (201) 838-1780.
4. Equal as approved by Architect before bidding. See Section 01 6000.

2.2 FINISHES

A. Clean and paint steel components. Thoroughly clean structural steel bases of welding slag and prime with zinc-chromate or metal etching primer. Etch and paint hot dipped galvanized steel components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Isolation Equipment:

1. Mount vibration isolated equipment on rigid steel frames or concrete bases unless Equipment Manufacturer certifies direct attachment capability.
2. Install snubbers with factory set clearances.
3. Piping:
   a. Protect isolated and non-isolated piping 2 ½ inches inside diameter and larger in all planes by restraints to accommodate thermal movement as well as restrain seismic motions.
   b. Locations shall be as scheduled and include, but not be limited to:
      1) At drops to equipment and at flexible connections.
      2) At 45 degree or greater changes in direction of pipe.
      3) At horizontal runs of pipe 30 feet maximum on center spacing.
      4) Gas piping shall have additional restraints as scheduled.

B. Vibration Isolation: Install piping to prevent transmission of noise and vibration into structure.

END OF SECTION 22 0548

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and section 220501 apply to this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install identification of equipment and piping as described in Contract Documents.

PART 2 - PRODUCTS

2.1 PAINT

A. Benjamin Moore Impervo or equivalent by Paint Manufacturer approved in Architectural Painting Sections.

B. Use appropriate primer.

2.2 LABELS

A. 1/8" Laminated Black Formica with white reveal on engraving. Value tags, brass with black lettering.

B. 1 ½" Brass valve tags with black lettered numbers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Stenciling

1. Locate identifying legends and directional arrows at following points on each piping system
   a. Adjacent to each item of equipment and special fitting.
   b. At point of entry and exit where piping goes through wall.
   c. On each riser and junction.
   d. Every 50 feet on long continuous lines.

2. Domestic Hot & Cold-Water Piping Identification
   a. Identify domestic hot and cold water piping above and below ceilings with stenciled letters "HW" and "CW" respectively.
   b. Letters shall be one inch high. Provide "Direction of Flow" arrow at each stencil.

c. Paint color shall be as specified below.

B. Painting: All pipe painting shall be provided for by the installing contractor i.e.: plumbing by the Plumbing Contractor.

1. All piping in Mechanical room shall be painted.
2. Paint natural gas piping outside the mechanical room.
3. All piping label, inside and outside mechanical room.

C. Identification shall comply with, but not limited to the following:

PIPE PAINTING AND LABELING LEGEND

SERVICE & LABEL	SYMBOL	LABEL COLOR * BACKGROUND	LETTER	PIPE COLOR **
DOMESTIC COLD WATER	DCW	GREEN	WHITE	DARK ROYAL BLUE
DOMESTIC HOT WATER	DHW	YELLOW	BLACK	MAGENTA
RAINWATER	RW	GREEN	WHITE	BROWN
SANITARY SEWER	SAN	GREEN	WHITE	BROWN
NATURAL GAS	G	YELLOW	BLACK	DARK GREEN

* Ref. ANSI codes 13.1 (1981). See Specs.

** Exposed piping in mechanical rooms, boiler rooms, etc., shall be painted color indicated on chart.

D. SIZE OF LETTERS AND LENGTH OF FIELD

OD OF PIPE OR COVERING	SIZE OF LETTERS	LENGTH OF COLOR FIELD
3/4 TO 1-1/2"	½"	8"
1-1/2" TO 2"	3/4"	8"
2-1/2 TO 6"	1-1/4"	12"
8 TO 10"	2-1/2"	24"
OVER 10"	3-1/2"	32"

E. Paint Specification: All surfaces to be painted shall be prepared in accordance with the detailed painting specifications in the Painting Section of these specifications. Surfaces that are not subjected to temperatures higher than 212 deg. F shall be painted as specified for the area in which they are located. Pipes, valves or other equipment subjected to temperature above 212 deg. F, shall be painted with heat resisting black enamel or heat resisting aluminum paint as specified below. The Owner's Representative shall designate surfaces to be painted aluminum painted at least three coats. Colors shall be selected by Owner's Representative.

F. Heat resisting black enamel shall be Sta-Black as manufactured by Pratt and Lambert Co., or Ebonite Boiler and Stack Paint as manufactured by W.P. Fuller Co. or approved equal suitable for use at temperatures of at least 45°F.

END OF SECTION 22 0553

SECTION 22 0600 - SCHEDULES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. The fixtures and equipment shown in the schedules are a part of this project and shall be included. Items in the schedules may or may not be found in the specifications but shall be included in the base bid.

B. The items stated in the schedule identify a quality of product and all substitutions shall be of that same quality.

C. If the named items have a delay in availability, notify the engineer immediately for a decision or an alternative.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The specified equipment shall be supplied and shall include the base unit with all the parts and pieces to install it into the system where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The scheduled items shall be installed in strict accordance with the manufacturer's recommendations and the details on the plans. If the details conflict in any way with the manufacturer's recommendations contact the engineer.

B. The installation shall not void the equipment warranty for any reason.

END OF SECTION 22 0600

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SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install insulation on:
   a. Above ground hot water, hot water returns and cold-water lines, fittings, valves, and accessories as described in Contract Documents.
   b. Underground piping
   c. Roof drain piping, water piping and fittings.
   d. Overflow drain and condensate piping and fittings.

B. Related Sections

1. General Conditions, Division 01, that apply to this Section.

PART 2 - PRODUCTS

2.1 INSULATION

A. On domestic water (U.N.O. on plan):

Cold Water	½" - 2"	½" Thick
	2" - Greater	½" Thick 1
Hot Water	½" - 1"	½" Thick
	1 1/4" - 2"	1 ½" Thick
	2" - Greater	1 ½" Thick
Roof & Overflow	2" - 4"	1" Thick
	5" - 7"	1" Thick

With factory vapor jacket.

B. Below grade joints shall be sealed with category four products ½" thick for 1" to 2" pipeand 1" for 2" and larger Snap-On closed cell polyolefin or elastomeric pipe insulation (U.N.O on plan).

1. Armacell 5200
2. Rubatex R373
3. Armstrong Armaflex

C. Approved Manufacturers

1. Manville
2. Owens-Corning

3. Knauf
4. IMCOA "ImcoLock"
5. Armstrong "Armaflex"

2.2 PVC FITTING, VALVE, & ACCESSORY COVERS

A. Approved Manufacturers

1. Knauf
2. Zeston

PART 3 - EXECUTION

3.1 APPLICATION

A. Piping

1. The insulation must be continuous, even though supports (at supports install asplit PVC pipe to cover insulation then clamp the split PVC to the support).
2. Apply insulation to clean, dry piping with joints tightly butted.
3. Adhere "factory applied vapor barrier jacket lap" smoothly and securely at longitudinal laps with a white vapor barrier adhesive.
4. Adhere 3-inch-wide self-sealing butt joint strips over end joints.
5. All joints and insulation ends shall be sealed in accordance with the manufacturers and industry practices.

B. Fittings, Valves, & Accessories

1. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
2. Cover insulation with one-piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
3. Alternate Method
   a. Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two 1/8-inch wet coats of vapor barrier mastic reinforced with glass fabric extending 2 inches onto adjacent insulation.

C. Pipe Hangers

1. Do not allow pipes to come in contact with the support hangers.
2. Provide 16 ga x 6-inch-long galvanized or PVC split shield over the insulation at each pipe hanger to protect pipe insulation from crushing by clevis hanger.

D. No insulation shall be applied until piping has been pressure tested and approved.

E. In Cold Attic Situations:

1. In all cold attic situations where the building insulation is located at the ceiling, all piping installed in the ceiling to roof space shall be insulated as specified herein.

2. In addition, install at 6" thick by 30" wide fiberglass blanket with vapor barrier (vapor barrier towards warm side of cavity) over the pipe to tent and allow heat loss through the ceiling to prevent the pipe from freezing. The insulation blanket shall be held in place by rolling it on a wood lathe and nailed to the joist. The building insulation shall then be applied over this pipe protection insulation.

F. Underground insulation shall be covered by slipping the insulation onto the pipe and sealing the butt joints. If slip-on is not possible, cut the insulation, install, then seal the seams and joints.

1. Insulation
   a. ½" thick Armaflex standard pipe insulation.
   b. Equals by Rubatex or IMCOA "Imcolock"
   c. All joints shall be sealed with Armstrong 520

G. In room installations where excess moisture or humidity will be present or when insulation is exposed in occupied spaces (from finished floor level to 10'-0" or ceiling height) (examples: kitchen, water lines, gym roof drain line, science rooms, stairways, hallways, etc.), provide and install a PVC or Aluminum pipe covering over fiberglass pipe insulation and seal this covering.

END OF SECTION 22 0719

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SECTION 22 0800 – COMMISSIONING OF PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. Before the Plumbing Contractor Commissions the system, he shall confirm the system has been installed as shown and detailed on the plans that all fittings are in place and installed as recommended by the manufacturer. He shall also confirm that the piping has been anchored as per the contract documents, and that all code conditions have been met. He shall also have known that:

1. All pressure lines shall be complete, supported, insulated and code tested andapproved.
2. All Waste and Vent lines are secured in place and have been code tested andapproved.
3. All server lines, drains, clean-outs, etc. are complete and likewise have been tested as per code.
4. The test reports shall have been submitted to the architect/engineer over the signature of the inspecting authority.
5. The specified insulation shall have been installed in accordance with the contract documents, manufacturer's recommendations and industry practices.
6. All piping shall have been cleaned of foreign debris, the domestic water lines sterilized in accordance with the specifications and current regulations have been adhered to.
7. The plumbing contractor, shall by his own admission, indicate the project is complete, charged for operation and ready for use.
8. Where equipment testing and/or start-up is indicated to be by a factory representative, this shall be completed. Report time of factory testing to the engineer 10-days prior to the test that he might be present.

PART 2 - TRAINING

2.1 The owner's representative and/or representatives shall be trained on the use and operation of each system.

A. This shall not only include operation of each system but include routine andannual maintenance required to extend the system longevity.

1. Replacement of seals, gaskets, etc.
2. Cleaning of filters, strainers, etc.
3. Anticipate life of regulators, seats, etc.

END OF SECTION 22 0800

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SECTION 22 0900 - INSTRUMENTATION AND CONTROL OF PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. The contractor shall provide and install all of the regulations, controls, etc. as not in the contract documents.

B. The contractor shall provide and install a liquid filled or dry as stated on drawings, pressure gauge upstream and downstream from the pressure regulator and at other locations as noted on the plans. These gauges shall be installed in the system with shut-off valves so they may be removed from the system without a system shut down. The dial size shall be listed on drawings.

1.3 TYPES OF GAUGES

A. The gauges shall be as manufactured by

1. Trerice
2. Ashcraft
3. Swagelok
4. Weiss

B. All gauges shall be liquid filled.

1.4 EXECUTION

A. The regulators and controls shall be installed in strict accordance with the manufacturer’s recommendations.

B. Each gauge shall be installed not more than 3-inches from the main line and shall havea ball type shut-off valve to isolate it from the line beingtested.

END OF SECTION 22 0900

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SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions, Division 01, and Sections 220501, 230000 and 260000 as theyapply to this Section.

B. Section 221116 Domestic water piping from a point 5 feet outside the building unless noted to the service main.

C. Section 220501-3.1 Criteria for performance of excavation and backfill.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install culinary water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines 5 feet from building perimeter.
2. Perform excavating and backfilling compactors required by work of this Section.

1.3 SUBMITTALS

A. Quality Control

1. Submit written report of sterilization test to Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. All pipe and fittings shall be domestic (USA) manufactured.

B. All valves shall be domestic (USA) manufactured.

2.1 PIPE

A. Type K copper for piping underground or beneath concrete slab. 3/4 inch minimum under slabs. Trap primer supplies shall be ½ inch.

B. Type L hard drawn copper for above ground applications.

C. Wirsbo Aquapex Tubing & Manifold. (Engel Method Extrusion Process). (Filter water and runs in pipe chases to islands only).

2.2 FITTINGS

A. Wrought copper.

B. ProPEX fittings. [Plastic only (EP)]

2.3 CONNECTIONS

A. Sweat copper type with 95/5 or 96/4 Tin-Antimony solder.

B. Joints under slabs, if allowed by local codes, shall be brazed.

2.4 BALL VALVES

A. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below. Valves shall be for 150 PSISWP.

B. Approved Manufacturers

1. Nibco-Scott T595 or S595 or equal by
2. ConBraCo (Apollo)
3. Crane
4. Hammond
5. Jenkins
6. Stockham
7. Watts

2.5 BACKFLOW PROTECTIONS

A. Approved Manufacturers-

1. Watts No. 909 or No. 009AQ - R.P. Backflow Preventer.
2. FEBCO Model No. 825 or Model No. 880 - R.P. Backflow Preventer.
3. Wilkins Model No. 550 - R.P. Backflow Preventer.

2.6 COMBINATION PRESSURE REDUCING VALVE/STRAINER

A. Integral stainless steel strainer, or separate Y strainer installed upstream of pressure reducing valve.

B. Built-in thermal expansion bypass check valve.

C. Approved Manufacturers

1. Watts U5B or equal by
2. Cash Valve
3. Thrush
4. Wilkins

2.7 MIXING VALVES

A. For 110° F 45° C Service.

1. Water inlets with stop valves, check valves, and removable strainers.
2. Water outlet with volume control valve and direct reading dial thermometer.
3. Flow: 1 GPM with maximum 5 psi pressure drop.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping under slabs without joints where possible.

B. Locate cold water lines a minimum of 6 inches from hot water line.

3.2 FIELD QUALITY CONTROL

A. Before pipes are covered, test systems in presence of Architect at 100 psi hydrostatic pressure for two hours and show no leaks.

B. Sterilize domestic water system with solution containing 250 parts per million minimum of available chlorine. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and faucets several times during that time.

C. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.

D. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION 22 1116

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SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install items specified in this Section and/or described in Contract Documents.
2. All pipe, fittings, and valves shall be domestic (USA) manufactured.

PART 2 - PRODUCTS

2.1 FLOW CONTROL FITTINGS

A. Vandal proof type and fit faucet spout of fixture used. Flow shall be controlled as required by local codes.

2.2 CONDENSATE DRAINS

A. Provide Type L copper for condensate drains from air handling units, fan coil units, furnace coils, and cooler/freezers. Support piping and protect from damage.

B. Provide schedule 40 PVC for condensate from high tech furnaces, boiler, and water heater.

C. Install 3-inch-deep seal, vented water trap adjacent to coil connection.

D. If condensing equipment is installed without a clarifier, the condensate lines shall be PVC pipe and fitting. Secure all piping.

2.3 CONDENSATE PUMP

A. Rated at 225 gph at 15 feet total head. Complete with one-gallon polystyrene tank with pump and automatic float control. 1/5 hp, 120-volt, one phase, 60 Hertz.

B. Condensate piping shall be Type L copper.

C. Approved Manufacturers

1. Little Giant #VCL-45ULS

2.4 PRESSURE GAUGES

A. Cast aluminum case

B. Chrome plated ring

C. Clear glass window

D. Phosphor bronze alloy steel bourdon tube

E. ½ percent scale range accuracy

F. 4-1/2-inch diameter dial face

G. Range 0 to 100 psi.

H. Liquid Filled.

I. Approved Manufacturers

1. Trerice
2. Swagelok
3. Weiss
4. Ashcraft

2.5 BRASS GAUGE COCKS

A. Approved Manufacturers

1. Ashcroft
2. Weiss
3. Trerice
4. Swagelok

2.6 WATER HAMMER ARRESTERS

A. Provide and install a water hammer arrester at each hot and cold-water connection and battery of fixtures.

B. Water hammer arresters shall be sized in accordance with PDI WH-201, pre-charged, suitable for operation in temperature range 100 to 300 degrees F, and maximum 250 psi working pressure.

C. Water hammer arrestors shall be constructed of stainless steel.

D. Approved Manufacturers:

1. Josam
2. Wade
3. Zurn
4. J.R. Smith

PART 3 - EXECUTION

3.1 INSTALLATION

A. Connect gauges to pipe with ¼ inch connections ball valve.

END OF SECTION 22 1119

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SECTION 221316 - FACILITY SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

B. Section 220501-3.1 Criteria for performance of excavation and backfill.

C. Section 221313 Sewage piping from 5 feet out from building to main.

D. Section 022200 and 221322 Storm Drain piping.

E. Section 221313-3.1-G Installing of Copper roof jacks.

F. Section 221313-3.1-G2Furnishing and installing of lead roof jacks.

G. Section 078400 Quality Fire Stop Material.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet out from building where applicable.
2. ASTA Testing and Material Standards No. 74, 564, 891, 2235, 2231, 2321, etc.
3. Perform excavation and backfill required by work of this Section.

B. Products Furnished But Not Installed Under This Section

1. All roof flashings.
2. Verify with roofing contractor for type of roof flashing to match roofing material and warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. All pipe and fittings shall be domestic (USA) manufactured.

2.2 BURIED LINES

A. Service weight, single-hub type cast iron soil pipe and fittings meeting requirements of ASTM A 74-87, "Specification for Cast Iron Soil Pipe & Fittings".

B. Plastic pipe conforming to IAPMO and ASTM specifications will be acceptable where permitted by local code (ABS or PVC schedule 40 pipe).

C. Service Weight, no-hub, cast iron soil pipe or as approved by local code.

D. Joint Material

1. 50% oakum and 50% lead, well calked.
2. Rubber gaskets meeting requirements of ASTM C 564-88, "Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings".
3. No-Hub Pipe- Neoprene gaskets with stainless steel cinch bands
4. As recommended by the pipe manufacturer of plastic pipe.

2.3 ABOVE GRADE PIPING & VENT LINES

A. Same as specified for buried lines except schedule 40 or Galvanized steel piping may be used above grade.

B. Vent lines 2-1/2 inches or smaller may be Schedule 40 galvanized steel.

C. All ABS or PVC lines and fittings above finished grade shall be insulated for noise abatement.

D. Plastic pipe conforming to IAPMO and ASTM specifications will be acceptable where permitted by local codes.

E. Joint Material

1. Bell & Spigot Pipe - 50% oakum and 50% lead, well calked, or rubber gaskets meeting requirements of ASTM C 564-88, "Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings".
2. No-Hub Pipe - Neoprene gaskets with stainless steel cinch bands.
3. Galvanized Pipe - Screwed Durham tarred drainage fittings.
4. Cleaning (Primers) and solvent cement (GWE) shall be installed as per manufacturer’s recommendations.
5. ABS or PVC - Glued fitting as per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not caulk threaded work, all piping must be solid, which will be installed in soil and hub fittings.

B. Slope horizontal pipe at ¼ in/ft.

C. Place cleanouts as follows.

1. Where shown on Drawings and near bottom of each stack and riser.
2. At every 90-degree change of direction for horizontal lines.
3. Every 100 feet of horizontal run.
4. Extend cleanout to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
5. Meet all code requirements for cleanouts.

6. All cleanout to grade and floor cleanouts shall be nickel bronze tops unless otherwise stated on the drawings.

D. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system, so gasses pass freely to atmosphere with no pressure or syphon condition on water seal.

E. Vent entire waste system to atmosphere. Discharge to parapet height above roof. Join lines together in least practicable number before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley.

F. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.

*** Roof systems other than concrete roof tile ***

G. Vent pipes passing through the roof are to have a roof flashing, fitted snugly around pipes and calk between flashing and pipe with flexible waterproof compound. Flashing base shall be at least 24 inches square. Coordinate with roofing contractor to match flashing to roofing materials.

1. Consult roofing contractor for exact type of flashings. Coordinate with the engineer and the roofing contractor for this information.

H. Refer to section 220529 for hangers and support of this piping.

3.2 FIELD QUALITY CONTROL

A. **Before piping is covered, conduct tests for leaks and defective work.** Notify Architect prior to testing. Correct leaks and defective work. Fill waste and vent system to roof level with water, 10 feet minimum, and show no leaks for two hours.

END OF SECTION 22 1316

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SECTION 22 1320 - FACILITY NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

1.2 SUMMARY

A. The gas contractor shall provide and install the gas piping (Natural Gas) from the point of service (outlet of gas meter) to the last piece of gas equipment being served, as shown on the plans.

B. The gas piping shall be supported as outlined in Section 220529.

C. Coordinate the piping with the serving utility. The gas contractor shall provide under this contract all the valves, connection components, etc. required to connect all the gas equipment.

D. If metered the gas utility shall provide the gas service lines the meter (Natural Gas), with the connections being made there to.

E. If the meter requires a base or protection from traffic, the gas contractor shall so provide.

1.3 QUALITY ASSURANCE

A. Qualifications

1. Welders shall be certified and bear evidence of certification 30 days prior to commencing work on project. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test. This shall be done at no cost to Owner. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. All pipe and fittings shall be domestic (USA) manufactured.

B. All valves shall be domestic (USA) manufactured.

2.1 FOR PIPING AND INSTALLATION SEE SECTIONS

A. Meet requirements of ASTM A 53-89a, "Specification for Pipe, Steel, Black & Hot-Dipped Zinc-Coated Welded & Seamless".

B. Carbon steel, butt welded, Schedule 40 black steel pipe.

2.2 FITTINGS

A. Black Pipe

1. Welded forged steel fittings meeting requirements of ASTM A 234-89a, "Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures", or standard weight 150 lbs., malleable iron screwed.

2.3 VALVES

A. 125 psi bronze body ball valve, UL listed

B. Approved Manufacturers & Models

1. ConBraCo - "Apollo" series 80-100
2. Jenkins - FIG-30-A
3. Jomar - Model T-204
4. McDonald - 3410
5. PGL Corp - "Red Cap" gas ball valve
6. Watts - Model B-6000-UL

2.4 EARTHQUAKE ACTUATED GAS SHUT-OFF VALVES

A. Aluminum Body Valve.

B. Stainless Steel Ball Shut-off.

C. Manual reset.

D. V.L., IAPMO, and A.6.A listed.

E. Approved Manufacturers:

1. Safe-T-Quake.
2. Koso
3. Quakemaster.

F. Gas Pressure Regulators

1. Fisher
2. Pietro Fiorentini-Governor

PART 3 - EXECUTION

3.1 FOR INSTALLATION ABOVE AND BELOW GRADE SEE SECTIONS

A. Pipe installed underground, through air plenums, in walls, and pipes 2-1/2 inches and larger shall be welded pipe and fittings. Other pipe may have screwed or welded fittings.

B. Wrap and lay underground pipe in accordance with local gas utility company regulations and specifications.

C. Install gas cocks on lines serving boilers, furnaces, duct heaters, and water heaters adjacent to boiler, furnace, or heater on outside of boiler, furnace, or heater cabinet and easily accessible.

D. Do not use flexible pipe connections to boilers, furnaces, duct heaters, or hot water heaters.

E. Install dirt leg with pipe cap, 6 inches long minimum, on each vertical gas drop to heating equipment.

F. Use fittings for changes of direction in pipe and for branch runouts.

G. Protection Coatings: All underground steel pipes shall be wrapped with "Scotchrap" NP. 50 tape to give not less than two complete layers on the entire underground piping system. Factory wrapped pipe in accordance with American Water Works Standard, or X-tru-Coast Plastic coated pipe will be acceptable.

H. Paint main gas valve red and label "Main Gas Shut-off" with a permanent label.

I. Install earthquake activated gas shut-off valve downstream of meter before entering building with gas line (required only in seismic zones 3 and 4).

END OF SECTION 22 1320

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SECTION 22 1513 - GENERAL SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions Division 01 and Section 22 0501.

B. Section 23 0000

1.2 SUMMARY

A. Provide and install a compressed air piping system as shown on the plans and stated here in.

B. The system shall be rigidly supported in place from the building structure - see Section 22 0529.

C. Provide and install all of the fittings, valves, joints, adapters, etc. as required for a complete and operable system.

1.3 SUBMITTALS

A. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Manufacturer’s Installation Instructions: Indicate hoisting and setting requirements, starting procedures.

1.4 PROJECT RECORD DOCUMENTS

A. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. All pipe and fittings shall be domestic (USA) manufactured.

B. All valves shall be domestic (USA) manufactured.

2.2 PIPE AND PIPE FITTINGS

A. Copper Tubing: ASTM B88, Type L hard drawn. (Above grade)

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper fittings.
2. Joints: ASTM B32, solder, Grade 95TA. (95/5)

B. Copper Tubing: ASTM B88, Type K annealed or hard drawn (below grade).

1. Fittings: ASME B16.26, wrought copper fittings.
2. Joints: ANSI/AWS A5.8, brazed, BCUP-4.

C. Polyethylene Pipe: (PP-R) ASTM F2389, SDR 7.4. Aquatherm Green (above & below grade).

1. Fittings: ASTM F2389 PP-R Resin (Fusiolen) fittings.
2. Joints: Fusion welded

D. IPEX “Duratec” Aluminum core with hope outer and inner layer ASTM E8 Fittings: Brass alloys with 0-ring seals ASTM F1974 (Above grade)

2.3 VALVES

A. Ball Valves

1. Approved Manufacturers:
   a. Nibco
   b. Hammond
   c. Watts
   d. Apollo

B. Swing Check Valves

1. Approved Manufacturers
   a. Nibco
   b. Hammond
   c. Watts
   d. Stockham

C. Air Outlets

1. Approved Manufacturers:
   a. Amflow

2. Quick Connectors: brass, snap on connector with self-closing valve.

D. Gauges

1. Provide and install pressure gauges at the indicated locations or at points of differential pressure.

E. Controls

1. Pressure Switch: Line voltage contractor to break at 100 psi with minimum differential of 200 psi.
2. Compressor Regulations: Lead-lag switch with time delay relay.
3. Electrical Alternation: Operate each compressor for 12 hours. If one compressor fails, second shall automatically maintain air pressure.

2.4 UNIONS AND COUPLINGS

A. Unions

1. Copper Tube and Pipe: 150 psig bronze unions with soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

C. Flexible Connector: Neoprene with brass threaded connectors.

2.5 PRESSURE REDUCING VALVE

A. Approved Manufacturers

1. Ingersoll-Rand
2. Other acceptable Manufacturers offering equivalent products.
   a. Amflow
   b. Wilkerson

B. Pressure Reducing Station: consisting of automatic reducing valve and bypass, and low-pressure side relief and gage. Provide oil separator where indicated.

C. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upwards from reduced pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: The piping system shall be complete and operable, but not limited to the following:

1. Make air cock and drain connection on horizontal casing.
2. Install line size ball valve and check valve on compressor discharge.
3. Pipe drain to floor drain.
4. Connect condensate drains to nearest floor drain.
5. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
6. Install valved drip connection at low points of piping system.
7. Install take offs to outlets from top of main, with shut off valve after takeoff. Slope take off piping to outlets.

8. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.
9. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
10. Identify piping system and components as noted in section 22 0553.

3.2 FIELD QUALITY CONTROL

A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.

B. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

C. Cap (seal) ends of piping when not connected to mechanical equipment.

END OF SECTION 22 1513

SECTION 22 1519 - GENERAL SERVICE PACKAGED AIR COMPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions Division 01 and Section 22 0501.

1.2 SUMMARY

A. A complete and operable reciprocating air compressor.

B. Air receiver and accessories.

C. Aftercooler.

D. Refrigerated air dryer.

E. Pressure reducing station.

1.3 SUBMITTALS

A. Shop Drawings: Indicate piping connections schematic with electrical characteristics, connection requirements, etc.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Manufacturer□s Installation Instructions: Indicate hoisting and setting requirements, starting procedures.

1.4 PROJECT RECORD DOCUMENTS

A. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

1.5 OPERATION AND MAINTENANCE DATA

A. Operation Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.

B. Maintenance Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for installation of pressure vessels.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of air receiver.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept air compressors, refrigerated air dryer on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.

C. Protect piping and equipment from weather and construction traffic.

1.8 MAINTENANCE MATERIALS

A. Provide maintenance materials under provision of section 22 0501.

B. Provide two quart containers of compressor oil.

PART 2 - PRODUCTS

2.1 COMPRESSOR

A. Approved Manufacturers

1. Ingersoll-Rand
2. Quincy
3. Campbell-Hausfeld

B. Type: Simplex or Duplex compressor unit as stated on the plans consisting of air-cooled compressor, air receiver, after cooler, pressure reducing station, spring isolators, and operating controls.

C. Compressor: Cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connecting rods, aluminum pistons with non-lubricated carbon rings, high-strength alloy suction and discharge valves. Statically and dynamically balance rotating parts.

D. Oil Pressure Switch: Equip compressor to automatically shut down compressor in event of oil pressure failure.

E. Capacity Reduction: Section valve unloader with lifting mechanism operated by oil pressure or solenoid valve. Provide for unloaded compressor start.

F. Base: One piece ribbed cast iron or welded steel base for motor and compressor with provision for V-belt adjustment.

G. Capacity as specified on the drawings.

H. Electrical Characteristics as specified on the drawings.

I. Motor: As specified on the drawings. See also Section 22 1513.

J. Controls:

1. Pressure Switch: Line voltage contractor to break at 100 psi with minimum differential of 200 psi.
2. Compressor Regulation: Lead-lag switch with time delay relay.
3. Electrical Alternation: Operate each compressor for 12 hours. If one compressor fails, second shall automatically maintain air pressure.

K. Wiring Terminations: Provide terminal lugs to match branch circuit conductors' quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

L. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Division 16.

M. Cord and Plug: Provide unit with 6' cord and plug for connection to electric wiring system including grounding connector.

2.2 AFTERCOOLER

A. Approved Manufacturers:

1. Ingersoll-Rand
2. Other acceptable manufacturers offering equivalent products.
   a. Amflow
   b. Wilkerson

B. Construction: Removable tube nests of non-ferrous metal tubes and corrosion resistant tube plates, safety valves, pressure gage, moisture separator, moisture drain valve, water inlet piping with automatic water valve, automatic condensate trap and overflow piping with open funnel.

C. Working Pressure: 135 psig.

D. Discharge: Cool air to within 12° F (7° C) of ambient air temperature at specified flow capacity.

2.3 AIR DRYER

A. Approved Manufacturers:

1. Amflow
2. Balston
3. Ingersoll Rand
4. Wilkerson

B. Type: Membrane or desiccant filter type capable of removing moisture in compressed air to a pressure dew point of 32°F, with a maximum pressure drop of 5 psig.

2.4 AIR RECEIVER

A. Approved Manufacturers

1. Ingersoll-Rand
2. Other acceptable manufacturers offering equivalent products.
   a. Quincy
   b. Campbell-Hausfeld

B. Receiver: Vertical, built to ASME regulations for working pressure of 125 psi (862kPa). Flange or screw inlet and outlet connections.

C. Fittings: Adjustable pressure regulator, safety valve, pressure gage, drain cock, and automatic float actuated condensate trap.

D. Tank Finish: Shop vinyl.

E. Size as specified on the drawings.

2.5 PRESSURE REDUCING VALVE

A. Approved Manufacturers

1. Ingersoll-Rand
2. Other acceptable manufacturers offering equivalent products.
   a. Amflow
   b. Wilkerson

B. Pressure Reducing Station: Consisting of automatic reducing valve and bypass, and low-pressure side relief and gage. Provide oil separator where indicated.

C. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upwards from reduced pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Review and install in accordance with manufacturer□s instructions.

B. Install compressor unit on an isolated 8" concrete housekeeping pad with 45° cambered edges. The pad shall have a ½ x 8” isolation strip around the base pad.

C. Install compressor unit on vibration isolators. Level and bolt in place.

D. Make air cock and drain connection on horizontal casing.

E. Install line size ball valve and check valve on compressor discharge.

F. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.

G. Pipe drain to the nearest floor drain.

H. Connect condensate drains to nearest floor drain.

I. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.

J. Install valved drip connection at low points of piping system.

K. Install take offs to outlets from top of main, with shut off valve after takeoff. Slope take off piping to outlets.

L. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.

M. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.

N. Identify piping system and components.

3.2 FIELD QUALITY CONTROL

A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.

B. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

C. Cap (seal) ends of piping when not connected to mechanical equipment.

D. A factory representative shall be present to start compressors that are 50-hp and larger. They shall be responsible for placing the unit in operation and instructing the owner on maintenance and operation.

END OF SECTION 22 1519

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SECTION 22 3436 - COMMERCIAL GAS DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01 Section 220501, 221116 and 220553 - General Plumbing Requirements.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install gas-fired storage type water heater as described in Contract Documents.

1.3 WARRANTY

A. Three-year tank warranty (all types) minimum.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS:

A. Condensing Type Water Heaters

1. Helical heat exchanger coil, pressure tested and rated for 160 psi w.p. complete with powered anodes, glass lined, down fired burner, temperature control, built-in diagnostics, ignition control device, digital temperature readout, CSA and ASME T & P valve, hand hole cleanout and 0" clearance.
2. 96 percent thermal efficiency.
3. Meet thermal efficiency and standby loss of U.S. Dept. Of Energy and ASHRAE.
4. 80-130 gallons
   a. Approved Model and Manufacturer
      1) Xi (BTH) by A.O. Smith
      2) Shield by Lochinvar
      3) Power-VT Plus by PVI
5. Conventional power-vent or power direct-vent (vertically or sidewall).
6. Provide neutralizer kit for each water heater. Pipe discharge of neutralized unit to nearest floor drain or floor sink.

2.2 ACCESSORIES

A. In seismic zones 3 and/or 4 (UBC Figure 23-2) provide and install anchoring components. Anchor to wall to resist horizontal displacement due to earthquake motion.

1. 1" x 18 Ga. galvanized steel straps.
2. #10 x 2-1/2-inch screws.

B. Provide and install water heater stand.

C. Water heaters shall have installed on the cold-water supply line a thermal expansion tank. Tank shall be of drawn steel construction with a Butyl rubber diagram, plastic lined, and pre-charged with 40 psi air. Maximum working pressure - 150 psi maximum temperature - 200°F. Tank shall be sized as noted on the drawings or as recommended by the manufacturer. Acceptable Manufacturers:

1. State Industries
2. Amtrol, Inc.

D. Check valves shall be spring loaded non-slam type, brass construction.

2.3 MANUFACTURERS

A. Amtrol Inc, West Warwick, RI (401) 884-6300 www.amtrol.com

B. A O Smith Water Products Co, Irving, TX (800) 527-1953
or (937) 667-2431 www.hotwater.com

C. Lochinvar Corporation, Lebanon, TN 37090, (615) 889-8900 www.lochinvar.com

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temperature-pressure relief valve on hot water heater and pipe discharge directly above funnel of floor drain.

B. Anchor water heaters to wall using two anchoring straps and specified screws.

C. Install hot water heater combustion and exhaust PVC piping premanufacture recommendations.

Combustion Air Pipe Size
3" dia => Total Equivalent Length **50 feet**
4" dia => Total Equivalent Length **120 feet**
Exhaust Vent Pipe Size
3" dia => Total Equivalent Length **50 feet**
4" dia => Total Equivalent Length **120 feet**
See 235133 combustion and exhaust air piping specification.

END OF SECTION 22 3436

SECTION 22 4201 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

B. Section 079200: Sealants used between fixtures and other substrates.

C. Section 221116: Domestic Water Piping

1.2 SUMMARY

A. Includes but not limited to

1. Furnish and install plumbing fixtures as described in contract documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.

B. Flow control fittings: Vandal proof type and fit faucet spout of fixture used. Flow shall be controlled as required by local codes.

2.2 MANUFACTURED UNITS

A. Water Closets

1. Maximum water usage of 1.6 gallons 6 liters per flush.
2. Standard fixture Manufacturers
   a. American Standard
   b. Toto
   c. Kohler
   d. Zurn

3. Handicap Accessible Fixture
   a. 18-inch maximum rim height.
   b. Manufacturers
      1) American Standard
      2) Zurn
      3) Kohler
      4) Toto

4. Seats
   a. Provide split front type with check hinge.

b. Approved manufacturers
   1) Standard And Handicap Accessible Fixtures
      a) Bemis
      b) Beneke
      c) Church
      d) Kohler
      e) Olsonite

5. Supply Pipe and Stop
   a. Provide chrome plating
   b. Approved Manufacturers
      1) Eastman
      2) Brasscraft
      3) Dearborn

6. Flush Valves
   a. Low flow 1.28 gallons 6 liters per flush maximum
   b. Proximity sensor type (Solar powered)
      1) Sloan

B. Urinals

1. Standard Fixture
   a. Approved manufacturers
      1) American Standard
      2) Zurn
      3) Kohler
      4) Toto

2. Handicap Fixture
   a. Approved manufacturers
      1) American Standard
      2) Zurn
      3) Kohler
      4) Toto

3. Carrier/Support
   a. Approved manufacturers
      1) Josam
      2) J.R. Smith
      3) Light Commercial Specialty Plumbing Products by Zurn.
      4) Wade
      5) Watts drainage

4. Flush Valve
   a. Low flow, 1.0.
   b. Proximity sensor type (Solar powered)
   c. Approved manufacturer
      1) Sloan

5. Flush Valve Filter
    a. Category four approved product. See section 01 6000 for definitions of categories.
        1) SFDG1 'Dirt Grabber' by South Fork Manufacturing

C. Standard Lavatories

1. Self-Supporting Fixtures
    a. Size: 20 by 18 inches.
    b. Approved manufacturers
        1) American Standard
        2) Zurn
        3) Kohler
        4) Bradley
    c. Carrier/Support
        1) Approved manufacturers
            a) Josam
            b) J.R. Smith
            c) Zurn
            d) Bradley
            e) Wade
            f) Watts Drainage

2. Countertop Fixture
    a. Size 20 by 17 inches, (maximum)
    b. Approved manufacturers
        1) American Standard
        2) Zurn
        3) Kohler
        4) Elkay

3. Fittings
    a. Faucet and Drain
        1) Provide flow control fitting on each spout in place of aerator
        2) Approved manufacturers
            a) Toto (faucet)
            b) Elkay - Drain
            c) Kohler - Drain
            d) Zurn - Drain
    b. Supply pipes with stops
        1) Provide 1/4 turn ball stops and chrome plating
        2) Approved manufacturers
            a) Dearborn
            b) Zurn
            c) Brasscraft

D. Handicap Accessible Lavatories

1. Self-Supporting Fixture
    a. Size: 20 by 27 inches.

b. Carrier/Support
   1) Approved manufacturers
      a) Josam
      b) J.R. Smith
      c) Zurn
      d) Wade
      e) Watts drainage Brass and Tubular
c. Approved manufacturers
   1) American Standard
   2) Zurn
   3) Kohler
   4) Bradley

2. Countertop Fixture
   a. Size 20 by 17 inches, maximum
   b. Approved manufacturers
      1) American Standard
      2) Zurn
      3) Kohler
      4) Elkay

3. Fittings
   a. Faucet and Drain
      1) Approved manufacturers
         a) Toto - faucet
         b) Elkay - drain
         c) Kohler - drain
         d) Zurn
   b. Supply pipes with stops
      1) Provide 1/4 turn ball stops and chrome plating
      2) Approved manufacturers
         a) Brasscraft:
         b) Tubular Brass Plumbing Products
         c) Zurn
   c. Traps
      1) 17 ga tube ‘P’ trap, chrome plated
      2) Approved manufacturers
         a) Dearborn
         b) Keeney Manufacturing
         c) Tubular Brass Plumbing Products
         d) Watts Drainage Brass and Tubular

4. Safety Covers
   a. Provide protection on water supply pipes and on trap
   b. Approved manufacturers
      1) Handy-Shield by Plumberex Specialty Products
      2) Handi Lav-Guard by TrueBro

5. All handicap accessible lavatories shall have traps and hot and cold-water supplies insulated with flexible vinyl insulation manufactured by Truebro, Inc. Handi Lav-Gaurd Model No. 120W or No. 105W.

E. Service Sink

1. Fixture
   a. Floor Type, 28 inches square with vinyl coated rim guard or 24 inches square with Stainless Steel rim guard.
   b. Approved manufacturers
      1) American Standard
      2) Acorn
      3) Kohler
      4) Stern-Williams

2. Fittings
   a. Supply
      1) Mounting height of 42 inches
      2) Provide 48-inch hose and clamp unless spout is threaded.
      3) Approved manufacturers
         a) American Standard
         b) Zurn
         c) Fiat
         d) Kohler
      b. Drain and Strainer
      1) Approved manufacturers
         a) American Standard
         b) Fiat
         c) Kohler
         d) Acorn
   c. Trap: Cast iron, PVC, or ABS to match piping

F. Stainless Steel Sink

1. Fixture
   a. Self-rimming, 18 ga stainless steel with luster tone finish
   b. Approved manufacturers
      1) Elkay
      2) Just
      3) Moen

2. Fittings
   a. Supply
      1) Provide flow control fitting on spout in place of aerator.
      2) Category four approved products. See section 01 6000 for definitions of categories.
         a) Brass Craft
         b) Dearborn
         c) Eastman
   b. Supply pipes with stops
      1) Provide 1/4 turn ball stops and chrome plating
      2) Approved manufacturers
         a) Brasscraft
         b) Dearborn
         c) Zurn

c. Waste
   1) Approved manufacturers
      a) Dearborn
      b) Elkay
      c) Just
      d) Kohler

d. Trap
   1) 17 ga tube 'P' Trap, chrome plated
   2) Category four approved products. See section 01 6000 for definitions of categories.
      a) Dearborn
      b) Keeney Manufacturing
      c) Zurn
      d) Brasscraft

G. Floor Sink

1. 8-inch square top, medium receptor cast iron body with flanged receptor, acid resistant coated interior, and acid resistant coated half grate. Aluminum sediment bucket and 2-inch calked regular outlet connection.
   a. Approved manufacturers
      1) J.R. Smith
      2) Josam
      3) Wade
      4) Zurn
      5) Commercial Enameling

H. Floor Drains and Drain Accessories

1. Floor Drain FD1
   a. Chrome strainer
   b. Provide a trap seal or trap primer on each floor drain.
   c. Approved Manufacturers
      1) Josam
      2) J.R. Smith
      3) Wade
      4) Zurn
      5) Watts

2. Floor Drain FD2
   a. Approved types with deep seal trap, chrome plated 8 to 12-inch diameter strainer. 2-1/2 to 4-inch diameter by 4-1/4-inch-high chrome plated funnel if listed on drawings.
   b. Provide a trap seal or trap primer on all floor drains.
   c. Approved manufacturers
      1) J.R. Smith
      2) Josam
      3) Watts
      4) Zurn
      5) Wade

I. Roof/Overflow Drains

1. Cast iron body, cast iron mushroom dome, sump receiver, and under deck clamps.
2. Approved Manufacturers
   a. Josam Co.
   b. J.R. Smith
   c. Wade
   d. Zurn

J. Exterior Hydrants

1. Provide with integral anti-siphon device. Key-operated
2. Non-freeze
3. Provide wall clamp on all hydrants.
4. Approved manufacturers
   a. Josam
   b. J.R.Smith
   c. Woodford
   d. Wade
   e. Watts Drainage
   f. Zurn

2.3 CLEANOUTS

A. Furnish wall cleanouts with chrome wall cover and brass or stainless-steel screws.

B. All other cleanouts will be nickel bronze top unless otherwise stated on the drawings.

1. Finish floors
2. Resilient Flooring
3. Finished Wall
4. Exposed Drain Lines
5. General Purpose

C. Approved manufacturers:

1. Josam
2. Wade
3. Zurn
4. J.R. Smith

2.4 MANUFACTURERS

A. Contact Information

1. American Standard Plumbing, Piscataway NJ www.americanstandard.com
2. Bemis Manufacturing Co. Sheboygan Falls, WI www.bemismfg.com
3. Beneke by Sanderson Plumbing Products, Columbus, MS www.sppi.com
4. BrassCraft Manufacturing Co. Novi, MI www.brasscraft.com
5. Cambridge Brass, Cambridge, ON www.cambridgebrass.com
6. Chicago Faucet Co, Des Plaines, IL www.chicagofaucets.com

7. Church Seat Co, Sheboygan Falls, WI www.bemismfg.com
8. Dearborn Brass, Tyler, TX www.dearbornbrass.com
9. Elkay Manufacturing Co, Oak Brook, IL www.elkay.com
10. Fiat Products, Evanston, IL www.craneplumbing.com
11. Josam Co, Michigan City, IN www.josam.com
12. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com
13. Just Manufacturing Co, Franklin Park, IL www.justsinks.com
14. Keeney Manufacturing Co, Newington CT www.keeneymfg.com
15. Kohler Co Plumbing Div, Kohler WI www.us.kohler.com
16. Light Commercial Specialty Plumbing Products by Zurn, Falconner, NY www.zurn.com
17. McGuire Manufacturing Co, Cheshire, CT www.mcguiremfg.com
18. Olsonite Corp, Newnan, GA www.olsonite.net
19. Plumberex Specialty Products, Palm Springs, CA www.plumberex.com
20. Powers Process Controls, Skokie, IL www.powerscontrols.com
21. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com
22. South Fork Manufacturing, Coalville, UT (801) 953-3001 www.dirtgrabber.com
23. Speakman Co, Wilmington, DE www.speakman.com
24. Stern-Williams Inc, Shawnee Mission, KS www.sternwilliams.com
25. T & S Brass & Bronze Works Inc, Travelers Rest, SC www.tsbrass.com
26. TrueBro Inc, Ellington, CT www.truebro.com
27. Tubular Brass Plumbing Products by Zurn, Falconner, NY www.zurn.com
28. Wade Div. Tyler Pipe, Tyler, TX www.wadedrains.com
29. Watts Drainage, Spindale, NC www.wattsdrainage.com
30. Woodford Manufacturing Company, Colorado Springs, CO www.watcomfg.com
31. Zurn Commercial Brass, Sanford, NC www.zurn.com

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures including traps and accessories with accessible stop or control valve in eachhot and cold-water branch supply line.

B. Mounting

1. Urinals
   a. Standard: 24 inches from floor to bottom lip
   b. Handicap Accessible: 17 inches from floor to bottom lip.
   c. Install urinals wall carriers
   d. Floor mounted

2. Self-Supporting Lavatories: Install wall carriers

C. Make fixture floor connections with approved brand of cast iron floor flange, soldered or calked securely to waste pipe. Make joints between fixtures and floor flanges tight with approved fixture setting compound or gaskets. Calk between fixtures and wall and floor with sealant specified in Section 07 9200. Point edges.

D. Flush Valve Filters.

1. Install in Sloan flush valves.
2. Install after water lines have been flushed out, but before turning water into flush valve.

3.2 CLEANING

A. Polish chrome finish at completion of project.

END OF SECTION 22 4201

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SECTION 22 4700 - WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General conditions Division 01 and Section 220501 apply to this section.

B. Section 221116: Domestic Water Piping

1.2 SUMMARY

A. Includes but not limited to

1. Furnish and install drinking water cooling system units as described in contract documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior exposed pipe, valves, and fixture trim shall be chrome plated.

2.2 WATER COOLED DRINKING

A. Handicap Accessible Bi-Level Fountain

1. Include accessory fountain. Vandal proof operating bar on front and both sides. Flexi-guard or chrome plated brass bubbler.
2. Category four approved products. See section 01 6000 for definitions of categories.
   a. AcornAqua
   b. Elkay
   c. Halsey Taylor
   d. Oasis
   e. Haws

2.3 MANUFACTURERS

A. Contact Information

1. AcornAqua, City of Industry, CA www.acornagua.com
2. Elkay Manufacturing Co, Oak Brook, IL
3. Halsey Taylor, Oak Brook, IL www.halseytaylor.com

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures with accessible stop or control valve

B. Mounting

1. Coordinate location of fountain with location and height of electrical outlet to ensure concealment of outlet by fountain.
2. Anchor bottom of fountain to wall.
3. Install Brasscraft stop (1/4 turn ball), escutcheon, and stainless-steel supply.
4. Install 1-1/4-inch IPS slip cast brass ‘P’ trap 17 Ga. Install trap so it is concealed
5. Top surfaces to be 40", above floor unless required otherwise by local code.

3.2 CLEANING

A. Polish chrome finish at completion of project.

END OF SECTION 22 4700

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SECTION 22 4710 - HANDICAP WATER COOLING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions, Division 01, and Sections 220501 General Plumbing Requirements and Section 221116 Pipe and Pipe Fittings apply to this Section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install handicap drinking water cooling system as described in Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior exposed pipe, valves and fixture trim shall be chrome plated.

B. Do not use flexible water piping.

2.2 HANDICAPPED FOUNTAIN

A. Vandal proof operating bar on front and both sides. One-piece stainless-steel back splash and basin. Flexi-guard or chrome plated brass bubbler. Handicap accessible B1-level fountains and single units.

B. Approved Manufacturers

1. Elkay
2. Halsey-Taylor
3. Haws
4. Oasis

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor bottom of fountain to wall.

B. Top surface to be 40" to 32" above floor unless required otherwise by local code.

C. Install Brasscraft stop (1/4 turn ball), escutcheon, and stainless-steel supply.

D. Install 1-1/4-inch IPS slip cast brass "P" trap 17 GA. Install trap so it is concealed.

END OF SECTION 22 4710

SECTION 23 0501 - COMMON HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

B. Related Sections: Refer to "Electrical Requirements for Heating-Ventilation and Air-Conditioning (HVAC) Equipment" Section 230000 for basic electrical requirements for all mechanical equipment. Special and specific electrical requirements are specified within each respective equipment specification section. See Sections 220000 Plumbing and Section 260000 Electrical.

1.2 SCOPE OF WORK - GENERAL

A. This section specifies the basic requirements for HVAC installations and includes requirements common to more than one section of. It expands and supplements the requirements specified in sections of Division 01.

B. The work covered by the HVAC Sections of the Specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, inspections, utilities, and incidentals necessary for the complete installation of all mechanical work required in the Contract Drawings.

C. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified under this section of work or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

D. The Contractor shall review all Contract Drawings and Specifications and include in his bid any work specifically as being performed in the HVAC. The Contractor shall be responsible for all work performed by his subcontractors.

1.3 DEFINITIONS

A. "Provide" shall mean "furnish and install complete and ready for intended use."

B. "Indicated" shall mean "indicated on drawings".

C. "Concealed" shall mean "hidden from sight as in trenches, chases, furred spaces or hung ceilings.

D. "Exposed" shall mean "not concealed", as defined above.

E. "Noted" shall mean "noted on drawings or in specifications".

F. "Contractor" also referred to as "this Contractor" or "the Contractor", shall mean "HVAC".

1.4 CODES AND STANDARDS

A. All mechanical work shall be in strict accordance with the most current edition of the International Building Code (IBC), International Mechanical Code (IMC), Uniform Plumbing Code (UPC), National Fire Protection Association (NFPA), International Fire Code (IFC), National Electrical Code (NEC), Energy Code IECC and ASHRAE-90.1, and all applicable state and local codes, laws and ordinances.

1.5 PERMITS AND FEES

A. The Contractor shall obtain and pay for all required permits and fees necessary to fully complete all work included in the Contract Drawings and Specifications.

1.6 CONSTRUCTION OBSERVATIONS:

A. During the course of construction of this project, the engineer shall visit the project site periodically on an as-needed basis. The construction observation intervals may vary depending on the progress and/or stage of construction and whether piping and/or ductwork, etc., is being placed below grade and/or concealed, surface mounted items, setting of equipment, equipment connections, etc. However, written field questions are encouraged and welcomed throughout the course of construction and shall be answered promptly in writing, to keep the project construction on schedule. The project foreman should have the building plans, construction schedules, etc., affixed in mind, so the mechanical systems being assembled, the setting of equipment, of parts and pieces, related to the project are anticipated, to prevent delays or emergencies.

(1) The engineer shall make one (1) final inspection. The contractor shall notify the engineer that the installation is complete, i.e., the systems are operating and have been tested and balanced, and everything is complete and operational, all equipment connections have been made and the owner's representatives have been trained. At this time the engineer, the contractor, and the owner's representative shall schedule a time to walk the project for evaluation, and record in writing the items found to be incomplete. The contractor shall make the corrections within one (1) week after this inspection.

B. On extra visits, the contractor shall report to the engineer that all systems are complete, and the project is ready for the owner's acceptance.

1.7 INTENT AND INTERPRETATION

A. The Drawings and Specifications are intended to supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.

B. The drawings are partly diagrammatic and do not necessarily show the exact location of all new piping and existing utilities, unless specifically dimensioned.

C. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining quantities or lineal runs of piping.

D. All grilles, fixtures or other pieces of equipment shall be centered on windows, wall spaces, or other items, unless specifically dimensioned otherwise.

E. The location of the ductwork shall be checked to determine that it clears all openings and structural members; that it may be properly concealed; and that it clears cabinets, lights and equipment having fixed locations.

F. HVAC drawings shall serve as the working drawings for this portion of the work but the Contractor shall refer to the Architectural, Structural, Plumbing and Electrical drawings for additional detail affecting the installation of his work. Architectural drawings shall take precedence over the HVAC drawings if any dimensional discrepancies exist.

G. The approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the approval of the Architect and he reserves the right to make any reasonable changes in the locations indicated without additional cost.

H. The contractor shall not make a change in a system, system layout, and/or equipment, except when he receives written approval or drawings with the signature of the engineer.

1.8 SUBMITTAL OF EQUIPMENT FOR APPROVAL

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 General Requirements for submittal definitions, requirements and procedures.

B1. ENGINEER APPROVED SHOP DRAWINGS OF DATA ON PRODUCT AND/OR EQUIPMENT BEING INSTALLED IN THIS PROJECT: After the contract is awarded the project and prior to the production of the specified equipment, the manufacturer shall have in hand an engineer approved shop drawing on that equipment being installed on this project. The manufacturer shall produce the product to comply with approved data. A brief description of submission to the engineer for evaluation is given below. Refer to identified sections for detailed submittal requirements.

B2. The **contractor shall submit one set of shop drawings** in a single binder (as stated in Section 1.11). From the submitted data the Design Engineer will review, make comments on or disapprove the submittals. The submittal will then be returned to the contractor via e-mail. Upon receipt of the e-mail, the contractor shall produce and assemble the required sets of shop drawings, operation and maintenance material, forming a manual that can be used by the owner in operating and maintaining the equipment.

C. Confirm equipment approved for the project.

1. Confirm that the equipment is approved for installation. It must be defined as to name, catalog number or both in the bid documents, which includes the published addendums. **If not approved, do not submit**.
2. Each unit shall state the name of the equipment manufacturer (name, address, phone, email, etc.) catalog number, size, physical dimensions and weight, energy characteristics (electrical and/or fuel), operating characteristics, materials from which constructed, any special conditions that may apply to the construction of the unit, etc.
3. The equipment must explain and define in detail the components that make-up the unit, so the owner and engineer can determine, define the replaceable parts during the life of the unit. Complete operating instruction, normal maintenance recommendations, start-up procedures, etc.

4. In general, the contractor shall acquaint himself with the equipment to confirm that it can be installed as shown on the plans and from his experience perform the indicated function in the system where installed.
5. In the course of reviewing the shop drawings, **the Contractor shall confirm the energy usage** (gas, power, air, water, drains, etc.) and determine if these services are available at the equipment characteristics. Namely: confirm voltage, phase, etc., with the electrical contractor. Natural gas available with the plumber, also drains, water (hot and cold) pipe sizes, etc., or if there is discrepancies in the services. If the indicated equipment services are not available, inform the engineer by phone and in writing, also note on the shop drawing. This cooperative effort will correct a problem before the equipment arrives at the job site.

   The shop drawings shall also indicate the scheduled delivery dates the equipment will be at the site.

   If the contractor foresees any problems with equipment size, weight, delivery, etc., it shall be noted in writing, attached to the shop drawings.

1.9 RECORD DOCUMENTS

A. Contractor shall record differences between mechanical work as installed and as shown in Contract Documents on a set of prints of mechanical drawings to be furnished by Architect. Return these prints to Architect at completion of project. Notations made on drawings shall be neat and legible. Comply with Division 1 General Requirements.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Contractor shall prepare and submit Operation and Maintenance Manuals for mechanical systems provided under this Contract. Comply with Division 1 requirements for procedures and requirements for preparation and submittal of manuals.

B. Manual binder shall have permanent lettering of a contrasting color. Information to beincluded on the binder is as follows:

1. The front cover shall be lettered as follows:

HVAC
OPERATION AND MAINTENANCE MANUAL
(PROJECT NAME)
(CITY AND STATE)
(YEAR)

OWNER:	(NAME)
ARCHITECT:	(NAME)
HVAC ENGINEER:	(NAME)
GENERAL CONTRACTOR:	(NAME)
HVAC CONTRACTOR:	(NAME)

The spine shall be lettered as follows:

HVAC O & M MANUAL (Year)
(Project Name)

C. Provide a master index at beginning of Manual showing items included. Use plastic tab indexes for sections of Manual.

D. Cover section shall consist of name, address, and phone number of Project Architect, General Contractor, Plumbing and HVAC Engineer, HVAC Contractor and all HVAC Sub-Contractors.

E. Provide a separate section for each section of the specifications. Provide index for each section listing equipment included. Include all items specified in Section 23. Provide a list of each type of equipment supplied with the local supplier's name, address and phone number.

F. Include descriptive literature (manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined. Data sheets shall be original. Copies are not acceptable.

G. When complete (before a construction begins) one (1) copy of the O & M Manual with approved submittals shall be placed in the Mechanical contractor's construction shack. At the close of the project, submit three (3) copies of manual shall be delivered to the owner at start-up and instruction for Owners use. Follow Division 01 requirements for additional manuals. Information to be included in manual:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping shut-down, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Schematic control diagrams (as built status) for each automatic control system. Mark correct operating setting for each control instrument on these diagrams. A second complete set of control diagrams encased in clear plastic laminate shall be furnished.
6. Valve schedule indicating the valve symbol (tag number), valve location by room number and description, valve purpose and system served, and valve size. Provide one corresponding set of full-size mechanical prints (as-builts status) showing these valve locations for cross-reference. A second complete set of valve schedules (8-1/2 in. x 11 in.) encased in clear plastic laminate and fitted in an aluminum holding frame shall be furnished to the Owner.
7. Testing, Adjusting and Balancing Report.
8. Test records and certifications.
9. Instruction period checklist.
10. Warranty information.

1.11 OPERATION AND MAINTENANCE INSTRUCTION AND TRAINING

A. The Contractor shall instruct the Owner's Representative(s) in the Operation and Maintenance procedures described in the Operation and Maintenance Manual. Comply with Division 1 requirements.

B. Individuals present shall include Contractors, Subcontractors, and equipment factory representatives. These individuals shall assist in instruction and start-up.

C. Minimum instruction time shall be eight (8) hours unless otherwise specifically noted.

D. All mechanical systems shall be properly functioning prior to instruction period.

E. Contractor shall prepare a checklist of all equipment and systems requiring instruction and maintenance for verification by the Owner's Representative of satisfactory start-up and instruction. A copy of this checklist shall be included in the Operation and Maintenance Manual.

1.12 GUARANTEE

A. Contractor shall guarantee the satisfactory operation of all material and equipment installed under Division 23 and shall repair or replace to the satisfaction of the Owner or Architect, any defective materials, equipment, or workmanship which may show itself within one year from the date of acceptance.

1.13 CLEANING

A. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish.

B. At completion of the job, the Contractor shall remove all tools, scaffolding, and surplus materials.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. All materials, in general, shall conform to the requirements of all agencies orpublications specified and described in Division 01 of the Contract Specifications.

B. Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

C. All specified materials and equipment shall be American manufactured and made.

2.2 LISTED EQUIPMENT

A. The current Electrical Code requires that all materials, devices, appliances, and equipment, shall be of a type that conforms to applicable standards or be indicated as acceptable by the established standards of the Underwriter's Laboratories, Inc. or other electrical product testing laboratories which are accredited by the department.

B. This statement is being interpreted by the State Electrical Inspector as follows: It is understood that many specialty items such as cast iron boilers, certain items of air handling equipment and other building components are not available with a UL label covering the entire piece of equipment. The State will impose no requirement that an item of equipment be UL labeled unless it is available as a UL labeled items from at least two manufacturers. Electrical components of unlabeled equipment, such as motors, shall be labeled if they are available from at least two manufacturers.

C. If any building component is available with a UL label from at least two manufacturers, an identical or similar unlabeled component shall not be acceptable for installation in the State of Montana. Should any such component be installed in the State of Montana, it shall either be inspected and labeled by a UL representative or other authority approved by the State or it shall be replaced with a UL labeled component, before the building will be accepted by the State Electrical Inspector.

D. Consequently, it shall be the sole responsibility of the Contractor (through project suppliers and equipment manufacturers) to purchase and install only equipment bearing the UL label whenever that equipment so labeled is available. The Contractor, (should any equipment be installed without the proper UL label) shall bear the entire cost of correction to the satisfaction of the Montana State Electrical Inspector.

2.3 SUBSTITUTIONS AND PRODUCT OPTIONS

A. Substitute equipment is encouraged if it is truly an equal to the specified items.

1. The items and/or equipment specified in the contract documents are standard manufacturers items found in suppliers' catalogs, except it be indicated as special. The designer has taken time and effort to analyze, evaluate and prove to himself that the specified units will perform the function needed, wherein it is placed. This means the responsibility for the function of the specified equipment rests with the designer, who knows and understands what is to be accomplished.
2. If a **supplier** and/or the **contractor** desires to substitute equipment in place of a specified item, he may do so, but he takes upon himself or herself the **full responsibility** that the substituted equipment will equal all of the performing characteristics, functions, etc., and/or exceed the performance of the specified item. The substitute equipment shall be of such a physical size and weight that it will mount in the designated location without alterations to the building and the structure will carry the load. If for any reason the substituted equipment requires alterations or modification, in any form to the building and/or the structure, the costs shall be paid by the contractor and/or those requesting the substitutions.

3. Those interested in requesting a substitution shall submit a substitution request. The **Substitution request will be considered if it is at the office of the Engineer eight (8) working days prior to the day of bidding. The request shall include the following:**
   - **a. A statement certifying that the equipment proposed is equal to that specified; that it has the same mechanical operating characteristics, compatible dimensions, weight, electrical characteristics and meets the function and intent of the equipment named in the contract documents;**
   - **b. The specification and catalog numbers of the substituted equipment;**
   - **c. A pictorial and specification brochure.**

4. Because of the short bidding period, (from issuance of drawing to bid date), between the substitution request and the bid date, the designer does not have adequate time to make a full evaluation of substitute equipment. Therefore, **those requesting the substitution** must accept **full responsibility** for the items being submitted for substitution (operating characteristics, physical size, weight, output, not increase the load, etc.). If at any time during the course of construction, **even up into the final completion**, if the designer finds the equipment does not meet the design criteria, comply with the performance, etc., **those requesting the substitution and the contractor have the responsibility to remove the substituted equipment and install the specified item at their expense.** There shall be no cost assessed to the owner and/or the designer and the replacement will not delay the completion of the project.

D. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure report any conflict, including catalog numbers, discontinued products, etc., does not believe the Contractor from meeting the intent of the contract documents, nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer, who will issue interpretation and/or additional instructions to Bidders before the project is bid.

E. Any conflict arising from the use of **substituted equipment shall be the responsibility of the contractor,** who shall bear all costs required to make the equipment comply with the intent of the contract documents.

F. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

G. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued. This substitution may be made by a change order.

H. Approved equipment shall be so noted, in writing in a formally issued **Project Addendum**

PART 3 - EXECUTION

3.1 COORDINATION

A. Each Contractor shall at all times cooperate with other trades on the job to avoid friction and delay to the progress of work. All points in dispute shall be referred to the Architect.

3.2 SUPERVISION

A. This Contractor shall have in charge of the work at all times a thoroughly competent superintendent. Comply with Division 01 requirements.

3.3 WORKMANSHIP

A. The work under the mechanical contract shall be performed by workers skilled in the particular trade and include all work necessary to properly complete the installation in a professional manner so as to present a neat and finished appearance.

3.4 EXAMINATION OF SITE

A. The Contractor shall visit the site of the proposed work and become familiar with the conditions affecting the work. Contractor shall verify all measurements at the building before beginning work.

3.5 SITE UTILITY SERVICES

A. Where applicable, the Contractor shall make connections to existing permanent source utilities related to his contract immediately so as to provide the use of this service by other trades. Comply with Division 01 requirements.

3.6 LAYING OUT WORK

A. Locations of equipment and devices, as shown on the drawings, are approximate unless dimensioned. Exact locations of such items shall be determined by the Architect s representative and/or secured from special details and drawings. Verify the physical dimensions of each item of mechanical equipment to fit the available space and promptly notify the Architect/Engineer prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor s responsibility.

B. The contractor **shall hand deliver to the general contractor** a written statement and/or a manufacturer’s brochure on the equipment being installed at each location. The information shall give the dimensions and weight (loads) of each unit being installed. The general contractor shall forward a copy of this information to the structural engineer and obtain from him confirmation that the building structure will accommodate the loads. If there be any problem the questioning party shall notify the mechanical engineer by phone and in writing.

3.7 CONTRACTOR COORDINATION

A. In the course of installing the systems defined in the contract documents, the contractor shall closely follow the plans, details and specifications (contract documents). The system design has been a careful and laborious undertaking, with the intent purpose of producing a system and/or system that will serve the owner well with a minimum of maintenance. Thence, the contractor shall adhere as closely as possible to the plans, details and specifications for each system. Questions and suggestions are encouraged as the project is being assembled. If for any reason, the contractor feels to deviate from the defined information, and finds a way, to improve the system, to make the system more easily assembled, make it operate more efficiently, etc., the contractor shall suggest the change to the engineer. Systems are designed to perform a specific function; the most minute change in assembly may change the function. If the engineer agrees with the change, he will authorize the contractor to proceed. Contractor cooperation and coordination is appreciated. If the contractor proceeds on construction without the designer's authorization, it shall be reworked, in accordance to plans and specifications, which work shall be at the contractor's expense.

3.8 CUTTING AND PATCHING

A. All cutting and patching of new or existing construction required for installation of mechanical systems and equipment specified in Division 23 shall be the responsibility of the Mechanical Contractor unless otherwise noted. Comply with Division 1 for general requirements for cutting and patching.

B. All cutting shall be performed with masonry saws, core drills or similar equipment to provide neat and uniform openings.

C. All patching shall match adjacent surfaces in materials and finish. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of HVAC installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of HVAC equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.

G. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.

H. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including, but not limited to removal of HVAC piping, heating units, ductwork plumbing , etc., and other HVAC items made obsolete by the new work.

I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.9 OPENINGS IN DUCTWORK

A. All temporary openings in ducts shall be capped or sealed during construction. Caps shall be removed for final connections.

3.10 PROTECTION OF MATERIALS AND EQUIPMENT

A. Contractor shall be held responsible for any and all materials and equipment to be installed under this contract and will be required to make good at his own cost any injury or damage which materials or equipment may sustain from any source or cause whatsoever before final acceptance. Comply with Division 01 requirements.

3.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

C. Coordinate deliveries of HVAC materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.12 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Access doors or hatches required for servicing of mechanical equipment shall be furnished and installed as specified in the other Divisions and Sections of the Specifications.

3.13 PAINTING

A. Contractor shall touch-up scratched, or damaged factory finishes of HVAC equipment. Comply with Division 01 requirements.

B. Unless otherwise noted, all other painting of HVAC related items shall be according Section 099123 "PAINTING".

3.14 LUBRICATION

A. Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. Comply with Division 01 requirements.

3.15 FINAL CLEANING

A. Refer to Division 01 for general requirements for final cleaning.

B. At time of final cleanup, all fixtures and equipment shall be thoroughly cleaned and left in condition for use.

END OF SECTION 23 0501

SECTION 23 0513 - ELECTRICAL REQUIREMENTS AND MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. This section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.

B. Specific electrical requirements for electric motor (i.e. horsepower, voltage, phase and electrical characteristics) for the mechanical equipment are specified within the individual equipment specifications and/or noted in the schedule on the drawings.

C. All magnetic motor starters and disconnect switches not furnished as an integral part of packaged mechanical equipment shall be provided under Division 23 -Mechanical.

D. Wiring from motors of mechanical equipment to disconnect switches or junction boxes, including pushbuttons, pilot lights, interlocks, speed controllers, and similar devices shall be the responsibility of this Contractor under Division 23 where not specifically indicated under Division 26.

E. Wiring of field-mounted float control switches, flow control switches, and similar mechanical/electrical devices provided for mechanical systems, to equipment control panels shall be the responsibility of this Contractor under Division 23 where not specifically indicated under Division 26.

F. Wiring required for Automatic Controls Section 230933 shall be the responsibility of this Contractor under Division 23.

1.3 REFERENCES

A. NEMA Standard MG 1: Motors and Generators.

B. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment.

D. NEMA Standard KS 1: Enclosed Switches. Comply with National Electrical Code (NFPA 70).

1.4 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves as required by the individual equipment specification sections.

1.5 QUALITY ASSURANCE

A. All electrical components and materials shall be labeled by an approved testing agency (UL, ETL, CSA, etc.).

PART 2 - PRODUCTS

2.1 MOTORS

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
3. Two-speed motors shall have two separate windings on poly-phase motors.
4. Temperature Rating: Rated for 40/C environment with maximum 50/C temperature rise for continuous duty at full load (Class A insulation). Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

B. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

C. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.

D. Bearings: Ball or roller bearings with inner and outer shaft seals; re-greaseable, except permanently sealed where motor is normally inaccessible for regular maintenance; designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor; for fractional horsepower, light duty motors, sleeve type bearings are permitted.

E. Enclosure Type: Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation; guarded drip-proof motors where exposed to contact by employee or building occupants; weather-protected Type I for outdoor use, Type II where not housed.

F. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

G. Noise Rating: "Quiet" rating on motors located in occupied spaces of building.

H. Efficiency: "Energy efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method "B". If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test method "B".

I. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features, and similar information.

2.2 STARTERS, ELECTRICAL DEVICES, AND WIRING

A. Motor Starter Characteristics: Enclosures NEMA, general purpose enclosures with padlock ears, except in wet location shall be NEMA 3R with conduit hubs. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and startup condition.

B. Manual switches shall have pilot lights and extra positions for multi-speed motors. Overload protection shall be melting alloy type thermal overload relays.

C. Magnetic starters shall have maintained contact pushbuttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated; trip-fee thermal overload relays each phase, interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections, built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts; externally operated manual reset, under-voltage release or protection.

D. Motor connections shall have flexible conduit, except where plug-in electrical cords are specifically indicated.

2.3 CAPACITORS

A. Features shall include individual unit cells, all welded steel housing, each capacitor internally fused, non-flammable synthetic liquid impregnated, craft tissue insulation and aluminum foil electrodes.

B. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower or larger, that have an uncorrected power factor of less than 85 percent at rated load.

PART 3 - EXECUTION

(Not Applicable).

END OF SECTION 23 0513

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SECTION 23 0548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING, DUCT WORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes but not limited to:

1. Quality of and requirements for anchorage and seismic restraint systems and vibration isolation systems for HVAC piping and equipment.

B. Related Sections:

1. Section 033000: Cast-In-Place Concrete.
2. Furnishing and installing of seismic restraint and vibration isolation systems is by installer of equipment requiring such systems. Manufacturers of equipment specified for seismic restraint shall provide product data needed for calculation of seismic restraint needs. This information shall include, but not be limited to, equipment dimensions, dimensioned anchor points, operating weight, and center of gravity dimension.

1.2 REFERENCES

A. American Society For Testing And Materials:

1. ASTM A 615-04b, Standard Specification for Deformed & Plain Billet-Steel Bars for Concrete Reinforcement.

B. Sheet Metal & Air Conditioning Contractors National Association / American National Standards Institute:

1. SMACNA / ANSI 001-2000, Seismic Restraint Manual: Guidelines For Mechanical Systems.

1.3 SUBMITTALS

A. Product Data:

1. Restraint system and anchorage method to be used for each piece of equipment.
2. Seismic restraints and calculations for all flexible mounted equipment.
3. Vibration isolators and flexible couplings.
4. Clearly outlined procedures for installing and adjusting isolators, seismic bracing anchors, and snubbers.

B. Shop Drawings:

1. Show size, hanger length, and location of seismic restraints for piping and ductwork.
2. Show details for each isolator and seismic brace with snubbers proposed for specified equipment.

3. Show details for proposed structural steel frames and rails and for anchors to be used in conjunction with isolation of equipment.
4. Show locations of piping and ductwork restraints on installation and fabrication floor plans (not bid set of documents of floor plans), noting size and type of restraint to be used.
5. Show details of supports, hangers, anchorage, and bracing for isolated equipment as designed or proposed by professional engineer employed by Restraint Manufacturer and qualified with seismic experience in bracing for mechanical equipment. Shop drawings submitted for seismic bracing and anchors shall bear engineer's signed professional seal.
6. Include anchor bolt calculations, signed and stamped by registered engineer, showing adequacy of bolt sizing and type.
   a. Calculations shall include anchor embedment, minimum edge distance and minimum center distance.
   b. Design lateral forces shall be distributed in proportion to mass distribution of equipment.
   c. Furnish calculations for anchors on restraint devices, cable, isolators, and on rigidly mounted equipment.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: System design and installation shall meet seismic requirements as defined in 2009 Edition of International Building Code, Section 1621 and applicable state and local codes in accordance with the site's Seismic Zone and with the minimum restraint capability of 0.075g. Explicit requirements and details can be found in referenced SMACNA Manual.

B. Seismic Requirements: Mechanical equipment, piping, and ductwork shall be braced, snubbed, or supported to withstand seismic disturbances and remain operational.

C. Vibration Isolation Requirements: Isolate equipment from structure by means of resilient vibration and noise isolators.

PART 2 - PRODUCTS

PROJECT SPECIFIC: Edit materials list below to include only those materials or elements that are actually part of the Mechanical design.

2.1 MATERIALS

A. Isolation And Seismic Equipment:

1. Piping: Restrain piping in accordance with Figures 4.11 to 4.19 in SMACNA Manual.
2. Equipment with Fixed Anchor or Support:
   a. Restraint designed according to the International Building Code.
   b. Horizontal force factor for elements of structures:
      1) In addition, vertical force restraint requirement shall be computed at 1/2 value of horizontal forces.
      2) Restrain equipment not anchored directly to floors by cable system designed and furnished by Restraint Manufacturer.

3. Ductwork: Restrain ductwork in accordance with Figures 4.2 to 4.10 in SMACNA Manual as appropriate.

B. Vibration Isolation Requirements:

1. Unless otherwise noted, isolate HVAC equipment one horsepower and over from structure by means of resilient vibration and noise isolators in accordance with ASHRAE HANDBOOK 2003 - HVAC Applications, Table 42, Chapter 47.
2. Design and install isolation equipment, hangers, connections, and other isolating devices to prevent transmission of vibration to structure from equipment and associated piping and ductwork.
3. For floor-mounted equipment, use recommendations of Table 45.
4. For roofs and floors constructed with open web joints, thin long span slabs, wooden construction and unusual light weight construction, evaluate equipment weighing more than 300 pounds to determine additional deflection of structure caused by equipment weight. Isolator deflection shall be 15 times additional deflection or deflection shown in Table 45, whichever is greater.
5. Under-Equipment Spring Isolators:
   a. Equal to Mason SSLFH earthquake motion restrained spring mounts with freestanding stable steel springs, leveling bolts, corrosion resistant finish, motion limiting design, uplift restraining bolts, and 1/4-inch ribbed neoprene noise stop pad.
   b. Isolators shall accept force in any direction up to 1.0 g without failure and shall limit movement to 3/4 inch in any direction.
   c. Springs shall have 50 percent overload capacity.
   d. Size as required to achieve specified static deflection.
   e. Outer diameter of spring proper shall not be less than 0.8 of spring height when in loaded position.

6. Overhead Support Spring And Rubber Hangers:
   a. Combination spring and neoprene hangers.
   b. Hanger bracket shall have 500 percent overload capability and shall allow up to 15-degree hanger rod misalignment without short-circuiting.
   c. Springs shall have 50 percent overload capacity.
   d. Provide seismic bracing as required.

7. Isolate piping and ductwork in mechanical equipment room and piping and ductwork three supports away or 50 feet from other mechanical equipment, whichever is greater, from structure by means of vibration and noise isolators.
   a. Isolate suspended piping with combination spring and fiberglass hangers in supporting rods.
   b. Support floor-mounted piping directly on spring mounts.

8. Isolate vertical pipe risers from structure using vibration and noise isolating expansion hangers having minimum rated deflection of four times anticipated pipe movement. Enclose in housing for fail-safe equipment.
9. Incorporate flexible connectors in piping adjacent to reciprocating equipment.
10. Incorporate flexible connections in ductwork adjacent to air-moving units.
11. Elastomeric Isolator: Neoprene or high-quality synthetic rubber with anti-ozone and antioxidant additives.

12. Nuts, Bolts, And Washers: Electroplated zinc.
13. Isolators Exposed to Weather: Cadmium plated and neoprene coated springs.

C. Seismic restraint equipment and resilient isolation devices shall be designed and furnished by single Manufacturer:

D. Type One Acceptable Manufacturers:

1. Amber / Booth Company, Houston, TX www.amberbooth.com.
2. Mason Industries Inc, Hauppauge, NY www.mason-ind.com.
3. Vibration Mountings and Control Inc, Bloomington, NJ (201) 838-1780.
4. Equal as approved by Architect before bidding. See Section 01 6000.

2.2 FINISHES

A. Clean and paint steel components. Thoroughly clean structural steel bases of welding slag and prime with zinc-chromate or metal etching primer. Etch and paint hot dipped galvanized steel components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Isolation Equipment:

1. Mount vibration isolated equipment on rigid steel frames or concrete bases unless Equipment Manufacturer certifies direct attachment capability.
2. Install snubbers with factory set clearances.
3. Piping:
   a. Protect isolated and non-isolated piping 2-1/2 inches 63 mm inside diameter and larger in all planes by restraints to accommodate thermal movement as well as restrain seismic motions.
   b. Locations shall be as scheduled and include, but not be limited to:
      1) At drops to equipment and at flexible connections.
      2) At 45 degree or greater changes in direction of pipe.
      3) At horizontal runs of pipe 30 feet 9000 mm maximum on center spacing.
      4) Gas piping shall have additional restraints as scheduled.

4. Ductwork:
   a. Protect isolated and non-isolated rectangular ductwork 4 sq ft in cross-sectional area and larger in all planes by restraints to accommodate thermal movement as well as restrain seismic motion.
   b. Locations shall be determined by Seismic Restraint Manufacturer and include, but not be limited to:
      1) Horizontal runs of ductwork 30 feet 9000 mm maximum on center spacing.
      2) 45 degree or greater changes in direction of ductwork.
      3) Each end of duct runs and drops of equipment.
      4) Each flexible connection.

B. Vibration Isolation: Install piping and ductwork to prevent transmission of noise and vibration into structure.

END OF SECTION 23 0548

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SECTION 23 0554 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section includes mechanical identification materials and devices.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product data for identification materials and devices.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Valve Schedules: Submit valve schedules for each piping system. Reproduce on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Furnish extra copies (in addition to mounted copies) for Maintenance Manuals.

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices after completion of covering and painting where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

A. General: Products specified are manufacturer’s standard products of categories and types required for each application as referenced in other Division 23 Sections. Where more than single type is specified for listed application, selection is Installer’s option, but provide since selection for each product category.

B. Stencils: Standard stencils, prepared with letter sizes conforming to recommendations of ASME A13.1. Minimum letter height is 1-1/4 inches for ducts and 3/4 inch for access door signs and similar operational instructions.

1. Material: Fiberboard or brass.
2. Stencil Paint: Exterior, oil-based alkyd gloss black enamel, except as otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based alkyd enamel in colors according to ASME A13.1, except as otherwise indicated.

C. Pressure-Sensitive Pipe Markers: Manufacturer's standard pre-printed, color-coded, pressure-sensitive vinyl pipe markers, with permanent adhesive conforming to ASMEA13.1.

D. Pipes smaller than 6 Inches: Full-band pipe markers, extending 360° around pipe at each location.

E. Pipes 6 inches And Larger: Either full-band or strip-type pipe markers, at least 3 times the letter height and of the length required for the label.

F. Lettering: Manufacturer's standard pre-printed terms as selected by Architect.

G. Lettering: Use piping system terms as indicated and abbreviate only as necessary or each application length.

1. Arrows: Either integrally with piping system service lettering (to accommodate both directions), or as separate unit, on each pipe marker to indicate direction of flow.

H. Plastic Tape: Manufacturer's standard color-coded, pressure sensitive, self-adhesive, vinyl tape, at least 3-mill. thick.

1. Width: 1-1/2 inches wide on pipes with outside diameters (including insulation) less than 6 inches; 2-1/2 inches wide for larger pipes.
2. Color: Comply with ASME A13.1, except where another color selection is indicated.

I. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Provide a 5/32-inch hole for fastener.

1. Material: 19-gage polished brass
2. Material: 0.032-inch thick aluminum
3. Material: 19-gage stainless steel
4. Material: 3/32-inch thick plastic laminate having 2 black surfaces and a white inner layer.
5. Material: Valve manufacturer's standard solid plastic.
6. Material: Size: 1-1/2-inches diameter, except as otherwise indicated.
7. Shape: As indicated for each piping system.

J. Valve Tag Fasteners: Brass chain (wire link or beaded type) or brass S-hooks.

K. Access Panel Markers: 1/16-inch thick engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.

L. Valve Schedule Frames: Glazed extruded aluminum display frame, with screws for removable mounting on masonry walls for each page of valve

1. Glazing: ASTM C 1036, 2.5 mm, single thickness, sheet glass.
   a. Type: Type I, flat transparent.
   b. Class: Class 1, clear.
   c. Quality: Glazing B, for general applications.

M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine sub core, except when other colors are indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraved with engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: 1/16 inch, for units up to 20 square inches or 8 inches length; 1/8 inch for larger units.
3. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

N. Plastic Equipment Markers: Laminated plastic, in the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of above criteria.
6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
7. Terminology: Include following, matching schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions and rpm.

8. Size: Approximate 2-1/2 by 4 inches for control devices, dampers and valves; and 4-1/2 by 6 inches for equipment.

O. Plasticized Tags: Pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing.

1. Size: Approximately 3-1/4 by 5-5/8 inches.
2. Fasteners: Brass grommets and wire.
3. Nomenclature: Large-size primary wording such as "DANGER," "CAUTION" or "DO NOT OPERATE."

P. Lettering and Graphics: Coordinate names, abbreviations and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same name are indicated, identify individual system number as well as service (such as Boiler No. 3, Air Supply No. 1H or Standpipe F12.)

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: Complying with ASME A13.1.
2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
   a. Fasten markers on pipes smaller than 6 inches by one of following methods:
      1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
      2) Adhesive lap joint in pipe marker overlap.
      3) Laminated or bonded application of pipe marker to pipe (or insulation).
      4) Taped to pipe (or insulation) with color-coded plastic adhesive tape, notless than 3/4-inch-wide, lapped 1-1/2 inches minimum at both ends of pipe marker, and covering full circumference of pipe.
   b. Fasten markers on pipes 6 inches and larger by one of following methods:
      1) Laminated or bonded application of pipe marker to pipe (or insulation).
      2) Taped to pipe (or insulation) with color-coded plastic adhesive tape, notless than 1-1/2 inches wide, lapped 3 inches minimum at both ends of pipe marker and covering full circumference of pipe.
      3) Strapped to pipe (or insulation) with manufacturer's standard stainless-steel bands.

3. Locate pipe markers and color bands as follows wherever piping is exposed infinished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   a. Near each valve and control device.
   b. Near each branch connection, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
   c. Near penetrations through walls, floors, ceilings or enternon-accessible enclosures.
   d. At access doors, manholes and similar access points that permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced at a maximum of 50-feet intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
   g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Valve Tags: Install valve tag on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shut-off valves, faucets, convenience and lawn-watering hose bibs, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

1. Install mounted valve schedule in each major equipment room.

C. Equipment: Install engraved plastic laminate signs or equipment markers on or near each major item of mechanical equipment. Provide signs for following general categories of equipment:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers and similar units.
3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption units.
4. Pumps, compressors, chillers, condensers and similar motor- driven units.
5. Heat exchangers, coils, evaporators, cooling towers, heat recovery units and similar equipment.
6. Tanks and pressure vessels.
7. Strainers, filters, humidifiers, water treatment systems and similar equipment.

D. Optional Sign Types: Stenciled signs may be provided instead of engraved plastic, at Installer's option, where lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

1. Lettering Size: Minimum 1/4 inch for name of unit where viewing distance is less than 2 feet, 1/2 inch for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
2. Terms on Signs: In addition to name of identified unit distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Plasticized Tags: Install within concealed space to reduce amount of text in exposed sign (outside concealment), where equipment to be identified is concealed above acoustical ceiling or similar concealment.

1. Identify operational valves and similar minor equipment items located in unoccupied spaces (including machine rooms) by installing plasticized tags.

3.2 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices which have become visually blocked by work of this Division or other Divisions.

END OF SECTION 23 0554

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SECTION 23 0593 - DUCT TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Includes but not limited to

1. Test, balance and adjust air duct systems as described in Contract Documents

1.3 SYSTEM DESCRIPTION

A. Performance Requirements

1. The air distribution systems shall be balanced by a Balancing or Engineering Firm with five years' experience in HVAC design and balancing. The report shall be stamped by a licensed engineer and certified by NEBB or AABC. The Balancing firm shall furnish the necessary instruments for making tests and performing work. The mechanical contractor shall include in his contract all costs including the Balancing Firm's charges.
2. Noise level shall not exceed PNC 35 for all supply and return air outlets and inlets when all mechanical equipment is operating.

1.4 SUBMITTALS

A. Quality Assurance/Control

1. Four copies of complete test data for evaluation and approval.
2. Test and Balance Report
   a. Complete with logs, data, and records as required herein. Print logs, data and records on white bond paper bound together in report form.
   b. Certified accurate and complete by Balancing Agency's certified test and balance engineer.
   c. Contain following general data in format selected by Balancing Agency.
      1) Project Number
      2) Project Title
      3) Project Location
      4) Project Architect and Mechanical Engineer
      5) Test and Balance Agency and Certified Engineer
      6) Contractor and mechanical sub-contractor
      7) dates tests were performed
      8) Certification Document
      9) Report forms similar to AABC standard format

d. Report shall include following:
   1) Preface suggesting abnormalities and problems encountered.
   2) Instrumentation list including type, model, manufacturer, serial number, and calibration dates.
   3) System Identification reporting location of VAV boxes, zones, supply, return and exhaust openings.
   4) Record following for each piece of air handling equipment.
      a) Manufacturer, model number and serial number.
      b) Design and manufacturer rated data.
      c) Actual CFM
      d) Suction and discharge static pressure of each fan.
      e) Outside-air and return-air total CFM
      f) Actual operating current, voltage, and brake horsepower of each fan motor.
      g) Final RPM of each motor.
      h) Fan and motor sheave manufacturer, model, size, number of grooves and center distance.
      i) Belt size and quantity.
      j) Static pressure controls final operating set points.

3. Bind approved copy of report in Operations and Maintenance Manual for Division 23

1.5 QUALITY ASSURANCE

A. Qualifications

1. Work of this Section shall be performed by independent Air Testing and Balance Agency specializing in testing and balancing of heating, ventilating, and cooling systems to balance, adjust and test air moving equipment, air distribution and exhaust systems.
2. Agency shall provide proof of having successfully completed at least five years of specialized experience in air and hydronic system balancing. Work by his agency shall be done under direct supervision of qualified heating and ventilating engineer employed by Agency
3. Agency shall be approved in writing by Architect.
4. Neither Architect's engineering consultant or anyone performing work on this Project under other Sections of Division 23 shall be permitted to do this work.

1.6 SCHEDULING

A. Award test and balance subcontract to Agency upon receipt of Notice To Proceed to allow Agency to schedule this work in cooperation with other Sections involved and to comply with completion date.

B. During construction, Agency shall inspect installation of pipe systems, sheet metal work, temperature controls, and other component parts of mechanical systems, perform inspections as follows.

1. One inspection when 60 percent of ductwork is installed
2. One inspection when 90 percent of equipment is installed.

C. Do not begin air testing and balancing until

1. After completion of air cooling, heating, and exhaust systems including installation of specialties, devices, and new filters.

2. Proper function of control system components including electrical interlocks, damper sequences, air and water reset, and fire and freeze stats has been verified.
3. Automatic temperature controls have been calibrated and set for design operating conditions.
4. Verification of proper thermostat calibration and setting of control components such as static pressure controllers and other devices that may need set points changed during process of balancing system

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND BALANCE COMPANIES

1. Environmental Engineers
2. Florite
3. Building System Technologies
4. Felthouse Balancing
5. Danis Test and Balancing
6. Bonneville Test & Balance LLC
7. BTC Services
8. Certified Testing & Balancing, Inc.
9. Independent Test and Balance
10. QT&B LLC
11. Test & Balance, Inc.
12. RS Analysis Inc.
13. Diamond Test and Balance
14. Testing company shall submit experience and history 14 days before bid day for approval.

3.2 PREPARATION

A. Heating, ventilating, and cooling systems and equipment shall be in full operation and continue in operation during each working day of testing and balancing.

3.3 FIELD QUALITY CONTROL

A. Site Tests

1. If requested, conduct tests in presence of Architect.
2. Instruments used by Agency shall be accurately calibrated and maintained in good working order..

3. Air Testing and Balancing Procedure
   a. Perform tests at high and low speeds of multi-speed systems and single speed systems, Perform following testing and balancing functions in accordance with Associated Air Balance Council National Standards.
      1) Fan Speeds
         a) Air Handling Units (with variable pitch pulleys and sheaves) Test and adjust fan RPM to achieve design CFM requirements.

         b) Furnaces and Fan Coil Units (with direct drive motors) Set fan speed to lowest possible setting that will achieve design CFM requirements. Adjust down from Contractor setting, if necessary.
      2) Current And Voltage: Measure and record motor current and voltage
      3) Pitot-Tube Traverse: Perform pitot-tube traverse of main supply and return ducts to obtain total CFM
      4) Outside Air: test and adjust system minimum outside air by pitot-tube traverse.
      5) Static Pressure: Test and record system static pressures, including suction and discharge static pressure of each fan.
      6) Air Temperature: Take wet and dry bulb air temperatures on entering and leaving side of each cooling coil. Dry bulb temperatures shall be taken on entering and leaving side of each heating unit.
      7) Zone ducts: Adjust zone ducts to within design CFM requirements. At least one zone balancing damper shall be completely open.
      8) Main Ducts: Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
      9) Branch Ducts: Adjust branch ducts to within design Cfm requirements. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
      10) Tolerances: Test and balance each diffuser, grille, and register to within 10 percent of design requirements.
      11) Identification: Identify the location and area of each grille, diffuser, register and terminal box. Record on air outlet data sheets.
      12) Description: Record size, type, and manufacturer of each diffuser, grille and register on air outlet data sheets.
      13) Terminal Boxes: Set volume regulators on terminal boxes to meet design maximum and minimum CFM requirements. Check temperature controls for proper operation and calibration. Read out diffusers connected to terminal boxes shall be read out in heating and cooling modes and record their readings on air outlet data sheets.
      14) Drafts: Adjust diffusers, grilles and registers to minimize drafts.
   b. Permanently mark all outside air, supply air, and return air damper positions after balancing has been completed.

4. Smoke testing, or some other approved means, may be required to determine leak locations if air balance report indicates that any system's CFM total is less than 10 percent of design CFM. Prior to test, verify that system's duct joints have been sealed as specified and that air moving device in question is supplying required design system air flow. Architect will approve test method required. If smoke test is selected, use following procedure. Provide necessary precautions to protect those performing or observing test from being exposed to smoke.
   a. Use zinc chloride smoke candles, titanium tetrachloride ampules or sticks, or other devices acceptable to Architect to generate smoke.
   b. Close openings in duct except for one opening at farthest end of duct run.
   c. Circulate smoke at pressurized condition of ½ inch 13 mm minimum water gauge static pressure.
   d. Report findings to Architect in writing.

B. Final Inspection and Adjustments

1. System shall be balanced, and reports submitted to Architect before final inspection.

2. Balancing Agency shall be represented at final inspection meeting by qualified testing personnel with balancing equipment and two copies of air balancing test report.
   a. Architect will choose and direct spot balancing of one zone. Differences between the spot balance and test report will be justification for requiring repeat of testing and balancing for entire building. If recheck testing demonstrates measured flow deviation of 10 percent or more from recorded information on report, report will be rejected, and new inspection and report will be made and resubmitted.
   b. Perform re-balancing in presence of Architect and subject to its approval.
   c. If re-balancing is required, submit revised air test and balance reports to architect before Substantial Completion.
   d. Spot balance and re-balance shall be performed at no additional cost to Owner.

3. Where furnace supplied to job site provides over 5 percent more air than schedule requirements, rooms supplied by that furnace shall have their supply air quantities increased by ratio of actual total air quantity supplied to minimum air quantity required by furnace schedule.

END OF SECTION 23 0593

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SECTION 23 0713 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. Section 230501 - Basic Mechanical Materials and Methods sections apply to work of this section.

C. Section 230713 - Acoustical insulation inside air ducts.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install insulation on air ducts outside building insulation envelope as described in Contract Documents.
2. Furnish and install insulation on supply, exhaust, return, and fresh air ducts and combustion air ducts within building insulation envelope.
3. Furnish and install insulation on other air ducts where indicated on Drawings.

PART 2 - PRODUCTS

2.1 INSULATION

A. 2-inch-thick fiberglass with aluminum foil scrim kraft facing and have a density of one lb/cu ft. (R-Value = 6.0) for inside building envelope.

B. 2-inch-thick fiberglass with aluminum foil scrim kraft facing and have a density of 1.5 lb/cu ft. (R-Value = 8.0) for outside building envelope

C. Approved Manufacturers.

1. Manville Microlite FSK
2. CSG Type IV standard duct insulation
3. Owens-Corning FRK
4. Knauf (Duct Wrap FSK)
5. Certaintred Standard

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct wrap in accordance with Manufacturer□s recommendations (overlap insulation4-inches).

B. Do not compress insulation except in areas of structural interference.

C. Completely seal joints.

END OF SECTION 23 0713

SECTION 23 0933 CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Section 230933 - Furnishing and installing of temperature control dampers.

D. Division 26 - Furnishing and installing of raceway (conduit) and junction boxes, including pull wires, for temperature control system except as noted above.

E. Division 26 - Power wiring to magnetic starters, disconnect switches, and motors.

F. Division 26 - Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install automatic temperature control system as described in Contract Documents.
2. Furnish and install conductors and make connections to control devices and equipment. Furnish and install exposed raceway (conduit) in Mechanical Rooms.
3. Calibrate, adjust, and set controls for proper operation, operate systems and be prepared to prove operation of any part of control system. This work is to be completed before pre-final inspection.

1.3 SYSTEM DESCRIPTION

A. Design Criteria

1. Install line and low voltage electrical wiring, raceway (conduit), and boxes in accordance with Division 26 of these Specifications.
2. System controls shall be single manufacturer's products.

1.4 SUBMITTALS

A. Shop Drawings

1. Provide three copies of shop drawing submittal data for review. See Section 230501 for definitions and procedures.

B. Operation & Maintenance Data

1. Upon completion of work of this Section and prior to final inspection, provide two copies of "as-built" ATC diagrams, schematics, catalog cuts, maintenance instructions, and written operating sequence for each furnace/fan system to be included in Operation & Maintenance Manual specified in Section 230501.

PART 2 - PRODUCTS

2.1 THERMOSTATS AND DAMPERS

A. Thermostat shall be low voltage type provided with dual point change over feature for both heating/cooling and ventilating stages. Wire the rooftop unit economizer damper controls.

B. Thermostats to be horizontally mounted.

C. Approved Thermostat Models

1. Trane Baysens008/108 w/remote sensor
2. All others by prior approval.

D. Approved Economizer Equipment Models

1. Honeywell W869D, M7415 and C7400.

2.2 CONDUCTORS

A. Color coded and #16 AWG Type TFN or THHN.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Run all wiring in conduit.

B. Safety Controls

1. Fresh air dampers shall close on fan shut-down, power failure, open fan motor disconnect switch, and when thermostat is in UNOCCUPIED mode.

C. Mount Room Thermostats 46" from floor to bottom of thermostat.

D. Mount damper actuators and actuator linkages external of air flow.

E. Provide fresh battery in each thermostat (Mallory MN1604 9-volt alkaline type or equal) and

3.2 FIELD QUALITY CONTROL

A. Field Service

1. Calibrate, adjust and set controls for proper operation, operate systems and be prepared to prove operation of any part of control system. This work is to be completed before prefinal inspection.

3.3 ADJUSTING, CLEANING

A. Remove unused wire and conduit from site and test system s controls for two days.

END OF SECTION 23 0933

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SECTION 23 0934 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Performance Requirements.

1. Thermostat shall control occupied status of fan system based on thermostat heating, ventilating and cooling set points. Fan shall run continuously in occupied modes and cycle in fan "auto" mode.
2. Auxiliary fan cycle switch is provided by thermostat sub-base and is to be used to cycle fan in Occupied mode on both heating and ventilating (Economizer).
3. Adjustable heating, ventilating and cooling set points shall control space temperature by activating either heating, cooling or damper equipment. Sensor and controls provide automatic change over between heating/cooling and ventilation.
4. Economizer shall open the fresh air damper to minimum position in occupied mode. On temperature rise, the economizer shall modulate the fresh damper open to maintain a mix air temperature of 45 to 60° F. Above 65° F, the economizer shall return to minimum fresh air position.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 23 0934

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SECTION 23 2300 - REFRIGERANT PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Section 232315 - Refrigerant piping Insulation

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install piping for refrigeration systems as described in Contract Documents.
2. All materials and equipment specified under this section shall be American manufactured and made.

1.3 QUALITY ASSURANCE

A. Qualifications

1. Refrigerant piping shall be installed by a refrigeration contractor licensed by State.
2. All materials and equipment specified under this section shall be American manufactured and made.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Meet requirements of ASTM B 280-88, "Specification for Seamless Copper Tube for Air Conditioning & Refrigeration Field Service", hard drawn straight lengths.

B. Do not use pre-charged refrigerant lines.

C. All materials and equipment specified under this section shall be American manufactured and made.

2.2 REFRIGERANT FITTINGS

A. Wrought copper with long radius elbows.

B. Approved Manufacturers

1. Mueller Streamline
2. Nibco Inc
3. Grinnell

4. Elkhart Products Corp

2.3 SUCTION LINE TRAPS

A. Manufactured standard one-piece traps.

2.4 CONNECTION MATERIAL

A. Brazing Rods

1. Copper to Copper Connections
   a. AWS Classification BCuP-4 Copper Phosphorus (6% silver).
   b. AWS Classification BCuP-5 Copper Phosphorus (15% silver).

2. Copper to Brass or Copper to Steel Connections
   a. AWS Classification bAg-5 Silver (45% silver).

3. Do not use rods containing Cadmium.

2.5 FLUX

A. Approved Manufacturers

1. "Stay-Silv white brazing flux" by J W Harris Co
2. High quality silver solder flux by Handy & Harmon

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install refrigerant piping underground or in tunnels.

B. Slope suction lines down toward compressor one inch/10 feet. Locate traps at vertical rises against flow in suction lines.

C. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary.

1. No soft solder (tin, lead, antimony) connections will be allowed in system.

D. Braze valve, sight glass, and flexible connections.

E. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

3.2 FIELD QUALITY CONTROL

A. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.

1. Draw vacuum on each entire system with vacuum pump to 300 microns using vacuum gauge calibrated in microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum. Isolate compressor from system piping using shut-off valves prior to pulling vacuum.
2. Break vacuum with Freon to be used and re-establish vacuum test. Vacuum shall hold for 30 minutes at 200 microns without compressor running.
3. Conduct tests at 70° F ambient temperature minimum.
4. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
5. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.

END OF SECTION 23 2300

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SECTION 23 2310 - REFRIGERANT PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Division 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. General Conditions, Division 01, and Sections 230501 and 230553 apply to this Section.

D. Section 232300 - Refrigeration piping

E. Section 236213 - Expansion valves for 2 through 5-ton condensing units

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install refrigeration specialties as described in Contract Documents except for expansion valves on 2 through 5-ton condensing units.
2. All materials and equipment specified under this section shall be American manufactured and made.

PART 2 - PRODUCTS

2.1 EXPANSION VALVES:

A. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.

B. Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.

C. Approved Manufacturers

1. Alco
2. Henry
3. Mueller
4. Singer
5. Sporlan

2.2 FILTER-DRIER

A. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with non-ferrous casing and Schraeder type valve.

B. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type using flared copper fittings.

C. Size shall be full line size.

D. Approved Manufacturers

1. Alco
2. Mueller
3. Sporlan
4. Virginia

2.3 SIGHT GLASS

A. Combination moisture and liquid indicator with protection cap.

B. Sight glass shall be full line size.

C. Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.

D. Approved Manufacturers

1. Alco
2. Asco
3. Mueller
4. Sporlan

2.4 MANUAL REFRIGERANT SHUT-OFF VALVE

A. Ball valves designed for refrigeration service and full line size.

B. Valve shall have cap seals.

C. Valves with hand wheels are not acceptable.

D. Provide service valve on each liquid and suction line at compressor.

E. If service valves come as integral part of condensing unit, additional service valves shall not be required.

F. Approved Manufacturers

1. ConBraCo (Apollo)
2. Henry
3. Mueller
4. Superior
5. Virginia

2.5 FLEXIBLE CONNECTORS

A. Provide in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons.

B. Anchor pipe near each flexible connector.

C. Connectors shall be for refrigerant service with bronze seamless corrugated hose and bronze braiding.

D. Approved Manufacturers

1. Pack less Vibration Absorbers Model VAF
2. Style "BF" Spring-flex Freon connectors by Vibration Mountings.
3. Anaconda "Vibration Eliminators" by Anamet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.

END OF SECTION 23 2310

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SECTION 23 2315 - REFRIGERANT PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve as described in Contract Documents.

PART 2 - PRODUCTS

2.1 FLEXIBLE FOAMED PIPE INSULATION

A. Thickness

1. 1 ½ inch for all pipe diameter.

B. Approved Manufacturers

1. Armaflex
2. Rubatex
3. CSG "Ultrafoam"
4. IMCOA "ImcoLock"

2.2 JOINT SEALER

A. Approved Manufacturers

1. Armaflex 520
2. BFG Construction Adhesive #105
3. Therma-Cel 950.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.

B. Stagger joints on layered insulation.

C. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.

D. Seal joints in insulation. Use black nylon 1" tie straps every two feet.

E. Insulate flexible pipe connectors.

F. Insulate thermal expansion valves with insulating tape.

G. Insulation exposed outside building shall have "slit" joint seams placed on bottom of pipe.

H. Insulate fittings with sheet insulation and as recommended by Manufacturer.

I. Paint exterior exposed insulation with two coats of white finish recommended by Insulation Manufacturer, except on Therma-Cel insulation.

END OF SECTION 23 2315

SECTION 23 3114 - LOW-PRESSURE STEEL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Section 230593 - Smoke testing

D. Section 230934 - Temperature control damper actuators and actuator linkages

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install above-grade ductwork and related items as described in Contract Documents.
2. All materials and equipment specified under this section shall be American manufactured and made.

PART 2 - PRODUCTS

2.1 DUCTS

A. Fabricate of zinc-coated lock forming quality steel sheets meeting requirements of ASTM A 527-85, "Specification for Sheet Steel Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality", with G 60 coating.

B. Use of aluminum, non-metallic, or round ducts is permitted only as directed on plans.

C. Kitchen hood exhaust ductwork shall be fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and NFPA 96.

1. Construct of 16 gage, carbon steel or 18 gage stainless steel, using continuous external welded joints.

2.2 DUCT JOINTS

A. Ducts with sides up to and including 36 inches shall be fabricated using SMACNA T-1 and T-3 joints.

B. Duct sizes over 36 inches shall be fabricated using SMACNA T-24 flange joints or prefabricated systems as follows -

1. Ducts with sides over 36 inches to 48 inches
   a. Transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA "E" or "G" Type connection).
   b. Approved Manufacturers
      1) Ductmate Industries Inc.,
      10760 Bay Meadows Drive, Sandy, UT 84092 (801) 571-5308
      Stockton, CA (800) 344-3270
      Pittsburgh, PA (800) 245-3188
      2) Nexus, Exanno Corp., P.O. Box 729, Buffalo, NY 14206 (714) 849-0545 3) WDCI, P.O. Box 10868, Pittsburgh, PA 15236 (800) 248-2355.

2. Ducts 48 inches & larger
   a. Ductmate/35, Nexus, or WDCI (Heavy) (SMACNA "J" Type connection).
   b. Approved Manufacturers
      1) Ductmate Industries Inc., 10760 Bay Meadows Drive, Sandy, UT 84092

      (801) 571-5308
      Stockton, CA (800) 344-3270
      Pittsburgh, PA (800) 245-3188
      2) Nexus, Exanno Corp., P.O. Box 729, Buffalo, NY 14206 (714) 849-0545 3) WDCI, P.O. Box 10868, Pittsburgh, PA 15236 (800) 248-2355.

2.3 FLEXIBLE EQUIPMENT CONNECTIONS

A. 30 oz closely woven UL approved glass fabric, double coated with neoprene.

B. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 250° F.

C. Approved Manufacturers

1. Cain - N-100
2. Duro Dyne - MFN
3. Ventfabrics - Ventglas

2.4 DUCT SEALER

A. Approved Manufacturers

1. Cain - Duct Butter or Butter Tak
2. Design Polymerics - DP 1010
3. DSC - Stretch Coat
4. Duro Dyne - S2
5. Hardcast - #601 Iron-Grip or Peel-N-Seal Tape 6. Kingco - 15-325
7. Mon-Eco - 44-41
8. Trans-Continental Equipment Co - Multipurpose Duct Sealant
9. United - Sheet Metal duct-sealer

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ducts

1. Straight and smooth on inside with joints neatly finished unless otherwise directed.
2. Duct panels through 48 inch dimension having acoustic duct liner need not be crossbroken or beaded.
3. Crossbreak unlined ducts and duct panels larger than 48 inch or bead 12 inches on center.
4. Securely anchor ducts to building structure with specified duct hangers attached with screws or C-clamps.
5. Brace and install ducts so they shall be free of vibration under all conditions of operation.
6. Ducts shall not bear on top of structural members.
7. Make duct take-offs to branches, registers, grilles, and diffusers as detailed on Drawings.
8. Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
9. Properly flash where ducts protrude above roof.
10. Install internal ends of slip joints in direction of flow. Make joints airtight using specified duct sealer.
11. Cover horizontal and longitudinal joints on exterior ducts with two layers of Hardcast tape installed with Hardcast HC-20 adhesive according to Manufacturer's recommendations.
12. Paint ductwork visible through registers, grilles, and diffusers flat black.

B. Install flexible inlet and outlet duct connections to each furnace, fan, fan coil unit, and air handling unit.

END OF SECTION 23 3114

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SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.

B. Related Sections:

1. Section 230933: Temperature control damper actuators and actuator linkages.
2. Section 233001: Common Duct Requirements.

1.2 REFERENCES

A. American Society for Testing and Materials:

1. ASTM A 653-02a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM C 665-01, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
3. ASTM C 1071-00, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Acoustical Material).

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Acoustical Liner System:

1. Duct Liner:
   a. One inch 25 mm thick, 1-1/2 lb 2.2 kg per cu meter density fiberglass conforming to requirements of ASTM C 1071. Liner will not support microbial growth when tested in accordance with ASTM C 665.
   b. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
      1) Ultralite or ToughGard by CertainTeed.
      2) Duct Liner E-M by Knauf Fiber Glass.
      3) Akousti-Liner by Manson Insulation.
      4) Aeroflex Plus by Owens Corning.
      5) Linacoustic by Johns-Manville.

2. Adhesive:
   a. Category Four Approved Water-Based Products. See Section 016000 for definitions of Categories.
      1) Cain: Hydrotak.

2) Design Polymerics: DP2501 or DP2502 (CMCL-2501).
3) Duro Dyne: WSA.
4) Hardcast: IA-901. 5)Kingco: 10-568.
6) Miracle: PF-101.
7) Mon-Eco: 22-67 or 22-76.
8) Polymer Adhesive: Glasstack #35.
9) Techno Adhesive: 133.
10) United McGill: Uni-tack.

b. Category Four Approved Solvent-Based (non-flammable) Products. See Section 016000 for definitions of Categories.
1) Cain: Safetak.
2) Duro Dyne: FPG.
3) Hardcast: Glas-Grip 648-NFSE. 4) Kingco: 15-137.
5) Miracle: PF-91.
6) Mon-Eco: 22-24.
7) Polymer Adhesive: Q-Tack.
8) Techno Adhesive: "Non-Flam" 106.

c. Category Four Approved Solvent-Based (flammable) Products. See Section 016000 for definitions of Categories.
1) Cain: HV200.
2) Duro Dyne: MPG.
3) Hardcast: Glas-Grip 636-SE.
4) Kingco: 15-146.
5) Miracle: PF-96.
6) Mon-Eco: 22-22.
7) Polymer Adhesive: R-Tack.
8) Techno Adhesive: "Flammable" 106.

3. Fasteners:
a. Adhesively secured fasteners not allowed.
b. Category Four Approved Products. See Section 016000 for definitions of Categories.
1) AGM Industries Inc: "DynaPoint" Series RP-9 pin.
2) Cain.
3) Duro Dyne.
4) Dyn Air: DWT or FWT
5) Omark dished head "Insul-Pins."
6) Gripnails may be used if each nail is installed by "Grip Nail Air Hammer" or by "Automatic Fastener Equipment" in accordance with Manufacturer's recommendations.

B. Flexible Equipment Connections:

1. 30 oz closely woven UL approved glass fabric, double coated with neoprene.
2. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 250° F 121° C.
3. Category Four Approved Products. See Section 016000 for definitions of Categories.
a. Cain: N-100.
b. Duro Dyne: MFN.
c. Dyn Air: CPN with G-90 galvanized off-set seam
d. Elgen: ZLN.

e. Ventfabrics: Ventglas.
f. Ductmate: ProFlex.

C. Duct Access Doors:

1. Factory built insulated access door with hinges and sash locks. Construction shall be galvanized sheet metal, 24 ga 0.635 mm minimum.
2. Fire and smoke damper access doors shall have minimum clear opening of 12 inches 300 mm square or larger as shown on Drawings.
3. Category Four Approved Products. See Section 016000 for definitions of Categories.
   a. Air Balance: Fire/Seal FSA 100.
   b. Air-Rite: Model HAD-2.
   c. Cesco: HDD.
   d. Flexmaster: Spin Door.
   e. Kees Inc: ADH-D.
   f. Nailor: 085H-01.
   g. Pottorff: 60-HAD.
   h. Ruskin: ADH-24.

D. Air Turns:

1. Single thickness vanes. Double thickness vanes not acceptable.
2. 4-1/2 inch 113 mm wide vane rail. Junior vane rail not acceptable.

E. Branch Tap for Flexible Ductwork:

1. Factory-manufactured rectangular-to-round 45 degree leading tap fabricated of 24 ga 0.635 mm zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.
2. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
3. Manual Volume Damper:
   a. Single blade, 22 ga 0.79 mm minimum
   b. 3/8 inch 10 mm minimum square rod with brass damper bearings at each end.
   c. Heavy-duty locking quadrant on 1-1/2 inch 38 mm high stand-off mounting bracket attached to side of round duct.

4. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
   a. ST-1HD by Air-Rite.
   b. STO by Flexmaster.
   c. HET by Sheet Metal Connectors.

2.2 MANUFACTURERS

A. Contact Information:

1. AGM Industries, Brockton, MA www.agmind.com.
2. Air Balance Inc, Holland, OH www.air-balance.com.
3. Air Filters Inc, Baltimore, MD www.afinc.com.
4. Air-Rite Manufacturing, Bountiful, UT www.air-ritemfg.com.
5. American Warming & Ventilating, Holland, OH www.american-warming.com.

6. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
7. Cain Manufacturing Company Inc, Pelham, AL www.cainmfg.com.
8. C&S Air Products, Montebello, CA www.csairproducts.com.
9. CertainTeed Corp, Valley Forge, PA www.certainteed.com.
10. Cesco Products, Minneapolis, MN www.cescoproducts.com.
11. Daniel Manufacturing, Ogden, UT (801) 622-5924.
12. Design Polymerics, Fountain Valley, CA www.designpoly.com.
13. Ductmate Industries Inc, East Monongahela, PA www.ductmate.com.
14. Duro Dyne, Farmingdale, NY www.durodyne.com.
15. Dwyer Instruments Inc, Michigan City, IN www.dwyer-inst.com.
16. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com.
17. Greenheck Corp, Schofield, WI www.greenheck.com.
18. Gripnail Corp, East Providence, RI www.gripnail.com.
19. Hardcast Inc, Wylie, TX www.hardcast.com.
20. Honeywell Inc, Minneapolis, MN www.honeywell.com.
21. Industrial Acoustics Co, Bronx, NY www.industrialacoustics.com.
22. Johns-Manville, Denver, CO www.jm.com.
23. Kees Inc, Elkhart Lake, WI www.kees.com.
24. Kingco - King Adhesive Corp, St Louis, MO (800) 233-8171 or (314) 772-9953.
25. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com.
26. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
27. Metco Inc, Salt Lake City, UT (801) 467-1572.
28. Miracle.
29. Mon-Eco Industries Inc, East Brunswick, NJ (800) 899-6326 or (908) 257-7942.
30. Nailor Industries Inc, Houston, www.nailor.com.
31. Omark.
32. Owens Corning, Toledo, OH www.owenscorning.com.
33. Polymer Adhesive Sealant Systems Inc, Irving, TX www.polymeradhesives.com.
34. Pottorff Company, Montebello, CA www.pottorff.com.
35. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
36. Sheet Metal Connectors Inc, Minneapolis, MN www.smconnectors.com.
37. Techno Adhesive.
38. Titus, Richardson, TX (972) 699-1030. www.titus-hvac.com
39. United McGill Corp, Columbus, OH www.unitedmcgill.com.
40. Utemp Inc, Salt Lake City, UT (801) 978-9265.
41. Ventfabrics Inc, Chicago, IL www.ventfabrics.com.
42. Young Regulator Co, Cleveland, OH www.youngregulator.com.

2.3 FABRICATION

A. Duct Liner:

1. Install mat finish surface on airstream side. Secure insulation to cleaned sheet metal duct with continuous 100 percent coat of adhesive and with 3/4 inch 19 mm long mechanical fasteners 12 inches 300 mm on center maximum unless detailed otherwise on Drawings. Pin all duct liner.
2. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation shall overlap sides. If liner is all one-piece, folded corners shall be tight against metal. Ends shall butt tightly together.
3. Coat longitudinal and transverse edges of liner with adhesive.

B. Air Turns:

1. Permanently install vanes arranged to permit air to make abrupt turn without appreciable turbulence, in 90-degree elbows of above ground supply and return ductwork.
2. Quiet and free from vibration when system is in operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Liner:

1. Furnish and install acoustic lining in following types of ducts:
   a. Supply air.
   b. Return air.

B. Flexible Connections: Install flexible inlet and outlet duct connections to each furnace.

C. Access Doors In Ducts:

1. Install at each manual outside air damper and at each motorized damper. Locate doors within 6 inches 150 mm of installed dampers.
2. Install within 6 inches 150 mm of fire dampers and in Mechanical Room if possible. Install on side of duct that allows easiest access to damper.

D. Dampers And Damper Accessories:

1. Install concealed ceiling damper regulators.
   a. Paint cover plates to match ceiling tile.
   b. Do not install damper regulators for dampers located directly above removable ceilings or in Mechanical Rooms.

2. Provide each take-off with an adjustable volume damper to balance that branch.
   a. Anchor dampers securely to duct.
   b. Install dampers in main ducts within insulation.
   c. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
   d. Where concealed ceiling damper regulators are installed, provide cover plate.

3. Install motorized dampers.

END OF SECTION 23 3300

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SECTION 23 3346 - NON-METAL FLEXIBLE DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Section 233114 - Volume dampers and sheet metal ducts

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

PART 2 - PRODUCTS

2.1 DUCTS

A. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict air flow after bending.

B. Nominal 1-1/2 inches thick, 3/4 lb./cu ft density (R-6) fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless foil vapor barrier jacket factory installed over flexible assembly.

C. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.

D. Approved Manufacturers

1. ANCO-FLEX
2. Flex-Aire - PF/UPC
3. Flexible Air Movers Inc
4. Thermaflex
5. Codywest - Type NIL-M
6. Flex Master - Type 8M

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct in fully extended condition free of sags and kinks, using six foot maximum lengths. Ductwork shall not be used for 45° to 90° elbows.

B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with ½ inch wide metal cinch bands and sheet metal screws.

END OF SECTION 23 3346

SECTION 23 3400 - EXHAUST FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install exhaust fans as described in Contract Documents.

1.3 QUALITY ASSURANCES

A. Requirements of Regulatory Agencies -

1. Bear AMCA seal and UL label.

PART 2 - PRODUCTS

2.1 CEILING MOUNTED EXHAUST FANS

A. Acoustically insulated housings.

B. Include shatterproof integral back-draft damper with no metal to metal contact.

C. True centrifugal wheels.

D. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.

E. Suitably ground motors and mount on rubber-in shear vibration isolators.

F. Provide wall or roof cap, as required.

G. Approved Manufacturers

1. Cook-Gemini
2. Greenheck Sp
3. PennBarry Zephyr

2.2 ROOF MOUNTED EXHAUST FANS

A. Direct drive or have adjustable pitch V-belt as noted on Drawings.

B. Wheels shall be backward curved, and housing shall be removable or hinged aluminum.

C. Isolate motor with vibration dampeners.

D. Provide motorized type back-draft dampers and interlocked with fan motors. Damper shall have 5% leakage.

E. Insulated, prefabricated metal roof curb shall be for flat or sloped roof as shown on Drawings.

F. Approved Manufacturers

1. Fans
   a. Acme
   b. PennBarry
   c. Cook
   d. Greenheck
   e. Jenn-Air

2. Standard curbs
   a. Acme
   b. PennBarry
   c. Cook
   d. Greenheck
   e. Jenn-Air

3. Sound attenuating curbs
   a. Acme
   b. PennBarry
   c. Cook
   d. Greenheck
   e. Jenn-Air

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor fan units securely to structure or curb.

END OF SECTION 23 3400

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents.

B. Related Sections:

1. Section 233001: General Duct Requirements.

1.2 MAINTENANCE

A. Extra Materials: Leave tool for removing core of each different type of grille for building custodian.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Supply Grilles And Registers:

1. Finish: Off-white baked enamel.
2. Removable core.
3. Category Four Approved Products. See Section 01 6000 for definitions ofCategories.
   a. Carnes
   b. J & J
   c. Krueger
   d. Metal*Aire
   e. Nailor
   f. Price
   g. Titus
   h. Tuttle & Bailey.

B. Ceiling Return and Transfer Grilles:

1. Finish: Off-white baked enamel.
2. 1/2-inch 13 mm spacing.
3. Category Four Approved Products. See Section 01 6000 for definitions ofCategories.
   a. Carnes
   b. J & J
   c. Krueger
   d. Metal*Aire
   e. Nailor
   f. Price

g. Titus
h. Tuttle & Bailey

C. High Side Wall Return Grilles:

1. Finish: Off-white baked enamel.
2. Category Four Approved Products. See Section 01 6000 for definitions ofCategories.
   a. Carnes
   b. J & J
   c. Metal*Aire
   d. Krueger
   e. Nailor
   f. Price
   g. Titus
   h. Tuttle & Bailey

D. Ceiling Diffusers:

1. Finish: Off-white baked enamel.
2. Category Four Approved Products. See Section 01 6000 for definitions ofCategories.
   a. Carnes
   b. J & J
   c. Krueger
   d. Metal*Aire
   e. Nailor
   f. Price
   g. Titus
   h. Tuttle & Bailey

2.2 MANUFACTURERS

A. Contact Information:

1. Carnes Co, Verona, MI www.carnes.com
2. J & J Register, Holland, MI www.jandjreg.com.
3. Krueger Air System Components, Richardson, TX www.krueger-hvac.com.
4. Metal*Aire by Metal Industries Inc, Clearwater, FL www.metalaire.com.
5. Nailor Industries Inc, Houston, TX or Weston, ON www.nailor.com.
6. Price Industries Inc, Suwanee, GA www.price-hvac.com.
7. Titus, Richardson, TX www.titus-hvac.com.
8. Tuttle & Bailey, Richardson, TX www.tuttleandbailey.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side. Level floor registers and anchor securely into floor.

3.2 ADJUSTING

A. Set sidewall supply register blades at 15 degrees upward deflection.

END OF SECTION 23 3713

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SECTION 23 3714 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install louvers connected to ductwork as described in Contract Documents.

B. Products Supplied but Not Installed Under This Section:

1. Architectural louvers not connected to ductwork.

C. Related Sections:

1. Section 062001: Installation of architectural louvers not connected to ductwork.
2. Section 233114: Low Pressure Steel Ductwork

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Louvers:

1. General:
   a. Extruded aluminum, with blades welded or screwed into frames.
   b. Frames shall have mitered corners.
   c. Louvers shall be recessed, flanged, stationary, or removable as noted on Drawings.
   d. Finish:
      1) Polyvinyledene Fluoride (PVF2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF2 in resin portion of formula. Thermo- cured two coat system consisting of corrosion inhibiting epoxy primer and topcoat factory applied over properly pre-treated metal.
      2) Color as selected by Architect from Manufacturer's standard colors.

2. Louvers Connected To Ductwork:
   a. 1/2-inch 13 mm mesh 16 ga 1.59 mm aluminum birdscreen.
   b. Category Four Approved Products. See Section 01 6000 for definitions of Categories.
      1) Air Control Products.
      2) Airolite.
      3) American Warming & Ventilating.
      4) Arrow United Industries.
      5) Carnes.
      6) Cesco.
      7) Industrial Louvers.
      8) Ruskin.
      9) Vent Products.

10) Wonder Metals. Architectural Louvers:

c. Aluminum bug screen.

d. Category Four Approved Products. See Section 01 60000 for definitions of Categories.

1) Airolite.
2) American Warming & Ventilating.
3) Equals by Air Control Products, Arrow United Industries, Carnes, or Industrial Louvers as approved by Architect before installation. See Section 01600.

2.2 MANUFACTURERS

A. Contact Information:

1. Air Control Products, Salt Lake City, UT (800) 245-2252 or (801) 262-9933.
2. Airolite Co, Marietta, OH www.airolite.com.
3. American Warming & Ventilating, Holland, OH www.awv.com.
4. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
5. Carnes Co, Verona, WI www.carnes.com.
6. Cesco Products, Minneapolis, MN www.cescoproducts.com.
7. Industrial Louvers Inc, Delano, MN www.industriallouvers.com.
8. Ruskin Manufacturing, Kansas City. MO www.ruskin.com.
9. Vent Products Co Inc, Chicago, IL www.ventprod.com.
10. Wonder Metals Corp, Redding, CA www.wondermetals.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings.

B. Where louvers touch masonry or dissimilar metals, protect with heavy coat of asphalt paint.

END OF SECTION 23 3714

SECTION 23 4100 - DISPOSABLE AIR FILTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Filters other than in air handling units specified in Sections specifying equipment in which filters are installed.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install filters used in air handling units.

PART 2 - PRODUCTS

2.1 AIR HANDLING UNIT FILTERS

A. 2 or 4-inch-thick, medium efficiency, disposable type pre-formed pleated design, having at least 4.5 sq ft of filtering media per sq ft of face area.

B. Media shall be reinforced non-woven cotton fabric, treated with adhesive similar to "Vyclad B" and continuously laminated to supporting steel wire grid conforming to configuration of pleats.

C. Media pack shall be sealed in a chipboard frame or beverage board.

D. Filters shall have rated average efficiency of (MERV 8) 70-84.9% on ASHRAE Test Standard 52.2 and be capable of operating with variable face velocities up to 500 FPM without impairing efficiency.

E. Initial resistance shall not exceed 0.30 inches w.g. at 500 FPM or 0.14-inch w.g. at 300 FPM. Filter shall be listed Class 2 by UL.

F. Approved Manufacturers

1. Type 30/30 by Farr Co
2. Mark 80 by Serv-Aire
3. HC Type 40 by Envopleat
4. DP2-40 by Air Guard

END OF SECTION 23 4100

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SECTION 23 5415 – ELECTRIC RADIANT WALL AND CEILING HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Includes But Not Limited To

1. Furnish and install wall heaters as described in Contract Documents.

1.3 QUALITY ASSURANCE

A. Units shall be UL listed and comply with NEC.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Fan type for recess mounting in wall.

B. 20 gauge minimum sheet metal casing.

C. Heating element shall be encased in steel finned casting and protected by thermal switch.

D. Fan motor shall be heavy duty enclosed and permanently lubricated.

E. Fan shall be precision balanced and fan-motor assembly mounted to be vibration free.

F. Units shall be controlled automatically by integral thermostat when heater is in "ON" position.

G. Heater shall have built-in fan delay.

H. Finish - Baked-on enamel.

I. Approved Manufacturers

1. Q□Mark
2. Markel

PART 3 – EXECUTION (NOT USED)

END OF SECTION 23 5415

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SECTION 23 5420 - ROOFTOP GAS HEATING/ AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 230501 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Includes but not limited to

1. Furnish and install packaged air conditioning units as described in Contract Documents.

1.3 SUBMITTALS

A. Warranty

1. Submit copy of specified warranty.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements

1. Air-Cooled Condensing Unit Section shall be UL approved and rated according to ARI Standards.
2. Air delivery of units certified in accordance with standard test code for centrifugal fans adopted by AMCA.
3. Furnace sections shall be AGA approved.

1.5 DELIVERY, STORAGE, & HANDLING

A. Ship units with lifting angles and fully charged with refrigerant R-410A.

1.6 SEQUENCING & SCHEDULING

A. Coordinate installation of specified accessories with Section 230501-3.14.

1.7 WARRANTY

A. 5-year warranty on compressors.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Units shall be completely factory assembled and tested.

1. Units shall include following
   a. Condenser coils
   b. Condenser fans and motors
   c. Interconnected wiring
   d. Prewired control panel
   e. Filter section
   f. Factory installed 100% modulating economizer cycle including motorized dampers and controls.
   g. Corrosion resistant all-weather cabinet
   h. Roof curb.
   i. Disconnect and outlet.

B. Air-Cooled Condensing Unit Section

1. Unit shall contain a strainer-dryer.
2. Furnish unit with time delay or cycle protection to prevent short cycling.

C. Condenser Coil -

1. ½ inch outside diameter copper tube with aluminum fins.

D. Compressor

1. Hermetic or semi-hermetic type mounted on vibration isolators.
2. Equip with crankcase heater.

E. Condenser Fan

1. Axial flow type propeller fan.

F. Refrigerant lines shall have

1. Flexible connections
2. Suction and liquid line service valves
3. Charging valves
4. Receiver valve

G. Controls

1. Low ambient and dual pressure. Pre-wired.

H. Furnace Sections

1. Aluminized or chromized heat exchanger.

2. Built-in draft diverter.
3. Gas shut-off valve.
4. High limit switches.
5. Fan switch safety pilot and control transformer.
6. Automatic electric ignition.
7. Provide orifice for LP fuel.

I. Fan Section

1. Centrifugal Fan - One or more.
   a. Double inlet.
   b. Double width forward curved Class I.
   c. Constructed and tested in accordance with AMCA requirements.

2. Furnish with flexible connections with weather protection on supply and return air take-offs.

J. Economizer - Horizontal

1. This accessory shall be either field or factory installed. 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. 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.
   a. Install contractor shall install a barometric relief damper in the return duct.

K. Refrigerant Coils

1. Constructed of copper tubes with mechanically bonded aluminum plate fins.
2. 1" filter rack with locking hinged door.

L. Cabinets

1. Galvanized, weather-proof, and coated inside and outside with corrosion-resistant paint.

M. Roof Curb

N. Approved Manufacturers

1. Carrier
2. Lennox
3. Trane
4. Bryant

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units on spring type vibration isolators.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service

1. Equipment Manufacturer to provide start-up service.

END OF SECTION 23 5420

SECTION 26 0501 - COMMON ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 01 Specification sections, apply to work of this section.

B. This is Division 26 of the project specifications; this coupled with the drawings are to be used in the construction of this project. Each section recorded hereafter makes reference to the electrical systems, equipment, materials, connections, etc., and apply to all the work making reference and/or titled Electrical and/or Electrical Contract Documents.

C. Architectural, Structural, Plumbing, Mechanical and other applicable and related documents are considered a part of the electrical documents insofar as they apply as if referred to in full.

1.2 SCOPE OF WORK

A. The scope of this project is to construct a complete electrical system for the Maverik Project. Each area shall be developed electrically to give proper illumination, power utilization, auxiliary networks, etc. When the project is complete all systems integrate into a total electrical network making the building a usable facility.

B. The auxiliary systems: Fire Alarm System (If required), shall cover the entire indicated facility and must function as a unit to meet the needs of all occupants. Thence, the equipment supplier, the installer, and the constructor shall work toward that end. Anything short of this objective will not meet the intent of the project, i.e., each system shall be complete and effectively perform the function for which it was designed.

Extent of electrical work is indicated on drawings and/or specified in Division 26 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items:

1. 260508 – Basic Electrical Materials and Methods
2. 260510 - Existing Facilities and Equipment
3. 260515 - Electric Service Connection
4. 260519 - Conductors and Cables
5. 260520 - Electrical Wiring Connections
6. 260522 - Heat Cable
7. 260526 – Grounding and Bonding
8. 260529 - Concrete Platforms and Bases
9. 260533 - Raceways for Electrical System
10. 260534 - Boxes, Pull Boxes, Conduit Bodies and Fittings
11. 260548 - Electrical Supports and Seismic Restraints
12. 260553 - Electrical Identification
13. 260913 - Electrical Power Monitoring
14. 260923 - Lighting Control Devices
15. 262413 - Electrical Service and Distribution Switchboards

16. 262416 - Integrated Panel Boards
17. 262726 - Wiring Devices
18. 262813 - Fuses
19. 262816 - Electrical Switches and Circuit Breakers
20. 262910 - Overcurrent Protective Devices
21. 262913 - Enclosed Controllers and Starters
22. 264313 Surge Protection Device
23. 265100 - Interior Lighting
24. 265200 - Emergency Lighting
25. 265600 - Exterior Lighting
26. 270000 – 280000 – Data, Telephone, and Television Surveillance
27. 270500 - Telephone Conduit and Boxes
28. 270510 - Telephone Equipment and Cabling System
29. 271000 - Data, Conduit and Boxes (Conduit Only)
30. 282000 - Television Surveillance System (Conduit Only)

C. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.

D. Divisions 27 & 28 shall be bid with Division 26 as many of the conditions stated there in are found in Division 26. Namely, conduit, boxes, support, seismic bracing, etc. **Do not separate Division 26 from Divisions 27 & 28, they are all one contract.**

1.3 CONTRACT DOCUMENTS AND EXAMINATION OF THE SITE

A. Each bidder shall study the construction documents (plans and specifications), visit the site of the proposed work to become fully acquainted with the conditions relating to the construction, so that the bidder understands the difficulties and restrictions attending the execution of the work to be placed under contract. From all of the above information, together with the cost of equipment, materials, labor, etc., the bidder shall then assemble and submit acost to complete the project. The failure or omission of any bidder to receive or examine any contract documents, form, instrument, addendum or other document or to visit the site and acquaint them self with existing conditions shall in no way relieve any bidder from obligations with respect to his bid or to the contract. Written addendums (formally issued) become a part and parcel to the construction documents. The submission of a bid shall be taken as prima facie evidence of compliance with this section.

1.4 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. Any person contemplating submitting a bid shall become familiar with the drawings, specifications and project site. If for any reason, the bidder of the proposed contract, is in doubt as to the true meaning of any part of the drawings, specifications, or other contract documents, or finds discrepancies in, or omissions from, the drawings and specifications the bidder shall submit a written request for an interpretation, correction and/or clarification to Architect/Engineer. The person submitting the request shall be responsible for its prompt delivery. **Any interpretation or correction of the contract documents prior to bid shall be made only by addenda duly issued**. An oral statement by anyone on any provision in the contract documents prior to the bidding is declared invalid.

B. After acceptance of the contract, the Contractor shall meet the intent, purpose and function of the contract documents and **no changes shall be made to the contract documents, except it be in writing and/or a drawing, over the signature of the engineer and/or the engineer's representative**. Any costs of materials, labor and equipment arising therefrom, shall bemade known to the owner's representative (Project Manager and/or the General Contractor) within 24 hours or the costs become the responsibility of the Contractor.

1.5 LAW AND REGULATION

A. The bidder s attention is directed to the fact of all applicable laws, ordinances and rules and regulations of all authorities having jurisdiction over construction of the project shall applyto contract throughout, and they shall be deemed to be included in the contract of the same as though here written out in full.

1.6 CONSTRUCTION OBSERVATIONS:

A. During the course of construction of this project, the engineer shall visit the project site periodically on an as-needed basis. The construction observation intervals may vary depending on the progress and/or stage of construction and to observe the electrical conduit rough-in above or below grade, setting of the main and branch panels, auxiliary units andpanels, surface mounted items, setting of equipment, equipment connections, etc. However, written field questions are encouraged and welcomed throughout the course of construction and shall be answered promptly in writing, to keep the project construction on schedule. The project foreman should have the building plans, construction schedules, etc., affixed in mind, so the electrical systems being assembled, the setting of equipment, of parts and pieces, related to the project are anticipated, to prevent delays or emergencies.

(1) The engineer shall make one (1) final inspection. The contractor shall notify the engineer that the installation is complete, i.e., the systems are operating and have been tested and balanced, and everything is complete and operational, all equipment connections have been made and the owner's representatives have been trained. At this time the engineer, the contractor, and the owner's representative shall schedule a time to walk the project for evaluation, and record in writing the items found to be incomplete. The contractor shall make the corrections within one (1) week after this inspection. If at the conclusion of the observation tour the owner and engineer determine that additional visits are required to complete the project, **the contractor shall reimburse the engineer at the rate of $600 for each site visit required, plus out of pocket expenses, until all items are acceptable to the engineer and owner. The contractor shall pay the engineer in advance of each inspection.**

B. Before scheduling an additional visit, the contractor shall report to the engineer that all systems are complete, and the project is ready for the owner's acceptance.

1.7 OFFICIAL, AGENT AND EMPLOYEES OF THE OWNER NOT PERSONALLY LIABLE

A. It is agreed, by and between the parties hereto that in no event shall any official, officer, employee, or agent of the Owner in any way be personally liable or responsible for any covenant or agreement herein contained whether expressed or implied, nor for any statement, representation or warranty made herein or in any connection with this agreement.

1.8 SUBLETTING AND SUBCONTRACTING

A. This Bidder is responsible for the construction stated or defined in this Contract and, as such, shall abide by the Subletting and Subcontracting Fair Practices Act as set forth and outlined in the General Conditions, Designation of Subcontractors.

1.9 CONTRACTOR COORDINATION

A. In the course of installing the systems defined in the contract documents, the contractor shall closely follow the plans, details and specifications (contract documents). The system design has been a careful and laborious undertaking, with the intent purpose of producing a system and/or system that will serve the owner well with minimum maintenance. The contractor shall adhere as close as possible to the plans, details and specifications for each system. Questions and suggestions are encouraged as the project is being assembled. If for any reason, the contractor desires to deviate from the defined information, because he discovers a way to improve the system, make the system more easily assembled, make it operate more efficiently, etc., the contractor shall present the changes to the engineer. Systems are designed to perform a specific function; the smallest change in assembly may change the function. If the engineer agrees with the change the engineer will authorize the contractor to proceed. Contractor cooperation and coordination is appreciated. If the contractor proceeds with construction without the designer's authorization, it shall be reworked, in accordance to plans and specifications, at the contractor's expense.

1.10 QUALITY ASSURANCE

A. Comply with the requirements of State and Local Ordinances. If a conflict occurs between these requirements and the contract documents, the most stringent requirements shall govern. The contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the contract documents which may be in excess of the aforementioned requirements, and not contrary to same.

B. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.

C. Employ only qualified craftsmen with at least three years of experience (in power equipment, conduit work, high voltage equipment, etc.). Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices (Media Standards of Installation). Provide a competent superintendent to direct the work at all times. Any person found incompetent by the General Contractor, Engineer, Architect, or Owner, shall be discharged from the project and replaced by satisfactory personnel.

D. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.11 MATERIALS AND WORKMANSHIP

A. All materials and equipment furnished and installed shall be first quality, new and meet the standards of NEMA, IPCEA, LS, UL, NFPA, UBC, OSHA, NEC, and shall bear their label wherever standards have been established and label service is available. Where materials and equipment are specified by manufacturer s name, the type and quality required is thereby denoted. The Architect shall be afforded every facility deemed necessary to inspect and examine the materials and apparatus being installed to prove the material quality and skill/competency of workmanship.

1.12 DEMOLITION, PATCH AND REPAIR

A. The Contractor is responsible for all block-outs, demolition, patching and repair of all finished interior surfaces pertaining to the installation of this particular phase of work. All repaired surfaces shall be finished (painted, etc.) to match the adjacent materials, finished and color.

B. When conduit passes through a ceiling and/or floor, block-out as required and/or core-drill - do not break out with a hammer of any type. The hole shall not be larger than half inch (½") more than the diameter of the conduit.

C. When conduit is indicated to be installed below an existing concrete slab, cut the slab with a diamond saw and/or cutting tool. Do not just rip up the surface unless the entire section is removed.

D. When conduit is to be installed below asphalt, concrete, lawn, etc. the surface shall be cut, not ripped up, with a back-hoe or other equipment (i.e., mechanically cut then remove material).

E. Seal around all electrical equipment penetrating outside walls, roofs, unheated spaces, air plenums, cold boxes, etc., with Dow Corning Silicone RTV foam.

F. All salvageable electrical equipment and materials that cannot be integrated into the new electrical network become the property of the Contractor and shall be removed from the premise.

G. Hard Surfaces: whenever demolition or excavation is required for the installation of the electrical system, it is the responsibility of the Contractor to make repairs and/or replacement of hard finish surfaces such as concrete, asphalt, etc.

H. The method of patching and repair shall follow good construction practices. All finished surfaces shall match materials, and finish (surface texture and finish - paint, etc.) wherein the demolition occurred.

I. Lawn replacement resulting from excavation is to be included in the bid.

1.13 EXCAVATION, BACKFILL AND BORING

A. The Electrical Contractor is responsible for all excavation and backfill related to the installation for Division 26. All work shall comply with the conditions stated herein and those noted in the Architectural Section under Earthwork.

B. When conduit is indicated to be installed below an existing concrete slab, cut the slab with a diamond saw and/or cutting tool. Do not just rip up the surface unless the entire section is removed.

C. Backfill: The Contractor shall backfill the excavated areas with the material removed provided it does not contain rocks larger than 0.15-inch in diameter. If the excavated material is larger than indicated, the excavated area shall be filled with sand.

D. Backfill materials shall be put in place in 4-inch lifts and compacted to 98% of the maximum dry density of ASTM 698 over the entire area of the fill.

E. After the backfill is complete, the finished surface shall match the adjacent surfaces, depth, quality finish, etc. (concrete, etc.).

F. Boring, or Auging - The contractor shall employ a firm skilled in installing underground utilities - piping, conduit, etc. for at least five (5) years, with care and concern the contractor shall drive the boring tool under the bleachers with care and concern. Any damage to the existing facility shall be repaired at the expense of the Boring Contractor. The installation shall follow and comply with the intent and details shown or the plans.

1.14 PROGRESS AND COORDINATION OF WORK

A. The electrical work shall be laid out in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Perform necessary cutting, drilling or channeling with care. Use skilled mechanics of the trades involved and repair damage to building or equipment at no additional cost to the Owner. Cutting, drilling or channeling through work performed by other trades shall only be done with the consent of the General Contractor. Cutting, drilling or channeling through structural members shall only be done with the approval of the Architect.

B. Cooperate with other trades to coordinate locations of electrical outlets and apparatus.

C. Perform for other trades, the electrical wiring and connections for all devices or apparatus where not specified herein or indicated on the drawings. Consult the Architectural and Mechanical drawings to avoid hiding switches, outlets and other equipment behind doors, cabinets, counters, heating equipment, etc. Buried electrical devices and/or connections shall be relocated as directed by Engineer and/or authority having jurisdiction, at no additional cost to the Owner.

D. Where conduit, outlets or apparatus are to be cast in concrete or encased, it must be located and secured by a journeyman or foreman present at the point of installation. The journeyman or foreman shall check the locations of the electrical items before and after the concrete and masonry installation and shall relocate displaced items.

E. No changes shall be made in the design or location of apparatus unless specifically approved in writing.

1.15 COORDINATION WITH CEILING AND MECHANICAL SUBCONTRACTORS

A. Meet at least twice with the Ceiling Contractor. The first meeting shall accomplish coordination of all ceiling types with the specified light fixtures. The second meeting shall be held at the project site prior to installing the ceiling to coordinate the fixture layout in each area, and to determine if the depth will allow the installation of the fixture. If a conflict occurs with the layout or depth, the Engineer shall be contacted immediately so the conditions can be adjusted. A letter confirming the second meeting shall be sent to the Engineer with a copy to the Architect.

B. Meet at least once with the Mechanical Contractor prior to fabrication and installation of the ductwork to coordinate the depth and location of light fixtures and ductwork in all areas. All conflicts must be resolved before light fixtures are released for shipment. A letter confirming this meeting shall be sent to the Engineer with a copy to the Architect.

1.16 WIRING DIAGRAMS

A. As soon as possible after the contract to proceed is signed, one print of the control diagrams shown on the contract documents shall be developed (utilize the information on the contract documents) and Control Subcontractors, showing all necessary connections required for the equipment and devices proposed for installation. These prints shall be reviewed and approved by the Mechanical, Electrical, and Controls Subcontractor, and then submitted to the Architect/Engineer for approval. The prints shall indicate all components that are to be wired into the control power circuit by the Electrical Subcontractor, with all terminals for external connections of the components identified and labeled to correspond to the manufacturer's designations. Internal or factory installed wiring or package-type components need not be shown. The shop drawings for the Control System to be installed by the Controls Subcontractor shall be prepared as a separate and complete submittal and need not be entirely repeated on the indicated prints except for the related electric connection. Color coding designations shall be indicated on the control power circuit wiring to be installed in the field by the Electrical Contractor.

B. Revised Drawings: After the Architect has approved the submitted copy of the control diagrams, the contract drawings will be revised, and the Contractor will be issued ten revised prints. The revised control diagrams shall be certified in writing as being acceptable to the Mechanical Design Engineer, Electrical Design Engineer, Mechanical Contractor, Electrical Contractor, and the Controls Contractor. The contract drawings will be revised by one of the two following procedures:

1. If the revisions to the controls diagram shown on the contract drawings are minor in the opinion of the Architect, the contract drawings will be revised and re-issued by and at the expense of the Architect.
2. If the revisions to the control diagrams shown on the contract drawings are ruled major in the opinion of the Architect/Engineer, the Prime Contractor shall prepare and submit a complete set of reproducible drawings of the control diagrams proposed for installation. These drawings shall be prepared on the same size sheets as the contract drawings and shall follow the same general format and quality of drafting as the contract drawings. After these reproducible drawings have been reviewed, approved and certified by the Architect/Engineer, the revised prints will be re-issued to the Contractor at the expense of the Design Engineers.

C. Changes during Construction: The complete responsibility and costs for changes to the approved control diagrams during construction and the resultant changes to the installation requirements not covered by contract change orders, shall be assigned to the respective section of these specifications under which the equipment is furnished.

1.17 SUBMITTALS OF EQUIPMENT FOR APPROVAL

A. SHOP DRAWINGS AND PRODUCT DATA BEING INSTALLED IN THE PROJECT: After the contract is awarded, but prior to manufacture or installation of any equipment, prepare complete Shop Drawings and Brochures for materials and equipment as required by each section of this specification. A brief submittal description of equipment that is approved for installation (bid documents or addendums), is given below. Refer to identified sections for detailed submittal requirements.

1. Conductors and Cables (Section 260519)
2. Metallic and Non-Metallic Conduit (Section 260533)
3. Power Logic and Power Conditioners (Section 260913)
4. Main Service Disconnect and Distribution Switchboards (Section 262413)
5. Branch Panelboards (Section 262416)
6. Receptacles, Switches, Low Voltage Switching, Cover plates, Cord Caps, Cord Connectors, Phone Jacks and Plates, Phone/Data Jacks and Plates, and Power Poles (Section 262726)
7. Motor and Circuit Disconnect Switches (Section 262816)
8. Overcurrent Protective Devices (Section 262910)
9. Motor Controllers and Starters (Section 262913)
10. Interior Building Luminaires, Drivers, etc. (Section 265100)

This list is not all inclusive. The contractor shall submit product information for all items being installed on the project, contained in the drawings or elsewhere in this specification.

B. The electrical foreman, shall become acquainted with the project, is asked to review the shop drawings prior to submission to confirm size, voltages, loads, etc. **This cooperative effort** will prevent problems from occurring during the course of construction. Any problems that may arise shall be phoned to the engineer and noted in writing and submitted with the shop drawings.

C. Submit complete, bound submittal in a loose-leaf binder large enough for all items (8 copies) to Architect. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to insure proper clearance for installation of equipment. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents.

D. A minimum period of two weeks, exclusive of transmittal time, will be required each time a Shop Drawing and/or Brochure is submitted or resubmitted for review. This period shall be considered by the Contractor when scheduling submittal data.

E. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document s requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.

F. Certifications shall be written or in the form of rubber stamp impressions as follows:

I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)

Signed _____

Position _____ Date _____

Observe the following rules when submitting Shop Drawings and Brochures.

1. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included, the submittal will be returned for re-submittal.
2. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Drafter skilled in this type of work. Shop Drawings shall be drawn to at least 1/4"-1-0" scale.
3. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs which describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.

1.18 OPERATION AND MAINTENANCE MANUALS

A. Provide operating instructions and maintenance data books for all equipment and materials furnished under this Division.

B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item.

C. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones B3-367-44). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.

D. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete list of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified.)

E. Include the following information where applicable:

1. Identifying name and mark number.
2. Certified outline Drawings and Shop Drawings.
3. Parts lists.
4. Performance curves and data.
5. Wiring diagrams.
6. Manufacturer's recommended operating and maintenance instructions.
7. Vendor's name and address for each item.

1.19 RECORD DRAWINGS

A. Maintain at the job site, on a daily basis, a complete set of "Record Drawings", reflecting an accurate dimensional record of all buried or concealed work. Mark "Record Drawings" to show the precise location of concealed work and equipment, including concealed or embedded conduit and junction boxes and all changes and deviations in the work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite authorization for such changes. The "Record Drawings" for daily recording shall consist of a set of blue line prints of the Contract Drawings.

B. Record dimensions clearly and accurately, delineating the work as installed; identify locations by at least two dimensions to permanent reference points.

C. Certify the "Record Drawings" for correctness by placing and signing the following certifications on the first sheet:

"CERTIFIED CORRECT (3/8" high letters)

By _____ Date _____
(Name of General Contractor)

By _____ Date _____
(Name of Electrical Contractor)

D. GUARANTEE: Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications and/or authorized changes. Without additional charge, replace any work or materials which develop defects, except from ordinary wear and tear, within one year from the date of substantial completion.

1.20 CLEAN-UP

A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.

B. Clean luminaires, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

1.21 POWER OUTAGE

A. All power outages required for execution of this work shall occur during non-standard working hours and/or at the convenience of the Owner. Include all costs or overtime work in the base bid.

B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.

C. Keep all outages to an absolute minimum.

1.22 STORAGE AND PROTECTION OF MATERIALS

A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work under way, and apparatus against loss or damage.

1.23 CONCRETE PADS AND ASPHALT

A. The Electrical Contractor shall provide the concrete (5-bag mix) and/or asphalt except as noted in the contract documents. This may also include that which is needed to replace any, and all removed through demolition. It shall match the existing as to type, quality and thickness.

1.24 ELECTRICAL-MECHANICAL COORDINATION

A. General - All disconnect means, motor controllers, electrical controls, signal devices, etc., for mechanical equipment as noted in Division 23 & 24 of the specifications shall be furnished, installed, wired, and connected under Division 26. All pressure switches, thermostats, solenoid valves, damper motors, smoke duct detectors, etc. shall be supplied and installed under the Mechanical Division for electrical connection under this Division. Connection diagrams will be supplied as hereafter explained.

B. If the substitution of equipment in Division 23 results in a change to the contract documents and/or changes to the installation requirements (not covered by the contract change orders), then the Division 23 contractor shall reimburse the Division 26 contractor for additional work required.

C. If the substitution of equipment in Division 26 results in a change to the contract documents and/or changes to the installation requirements (not covered by the contract change orders), the complete responsibility for costs shall be assigned to the section of these specifications under which the equipment is furnished.

D. Provide all control conduit (See Section 260533-2.1-G (2)) with pull cord for mechanical system. No conduit is required through accessible spaces between VAV box and control transformers.

1.25 EQUIPMENT CONNECTION DIAGRAM

A. Submittal data for each individual electrically operated or electrically controlled item of equipment or device furnished under Division 23 & 24 and/or 26 of the contract documents shall include complete electrical wiring diagrams and elementary control diagrams (ladder form) showing all internal and external wiring connections and services. The submittal data shall itemize all electrical characteristics that are of a special nature or critical to the electrical installation or control system. Such equipment and devices will not be considered for approval until these requirements are met.

PART 2 - PRODUCTS

2.1 GENERAL

A. PRODUCTS are specified by Manufacturer name, description, and/or catalog number and shall be supplied as such.

B. DISCREPANCIES between equipment specified and the intended function of equipment shall be brought to the attention of the Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents, nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Engineer, who will issue interpretation and/or additional instructions to Bidders before the project is bid.

C. MANUFACTURERS AND SUBSTITUTE ITEMS: Provide products of manufacturers specified. Manufacturer's catalog numbers and descriptions establish the quality of product required.

D. Provide only equipment specified in the contract documents or approved by addendum.

2.2 LISTED EQUIPMENT

A. Provide and install materials, devices, appliances, equipment, etc. that conforms to applicable standards or is indicated to be acceptable by the established standards of the Underwriter's laboratories, Inc., or other electrical product testing laboratories which are accredited by the department.

B. The statement in Item "A" above is being interpreted by the State Electrical Inspector as follows: It is understood that many specialty items such as power panels, light fixtures, devices and other building components are not available with a UL label covering the entire piece of equipment. The State will impose no requirement that an item of equipment be UL labeled unless it is available as a UL labeled item from at least two manufacturers. Electrical components of unlabeled equipment, such as motors, shall be labeled if they are available from at least two manufacturers.

C. If any building component is available with a UL label from at least two manufacturers, an identical or similar unlabeled component shall not be acceptable for installation. Should any such component be installed, it shall be replaced with a UL labeled component, before the building will be accepted by the Electrical Engineer.

D. Consequently, it shall be the sole responsibility of the Contractor (through project suppliers and equipment manufactures) to purchase and install only equipment bearing the UL label whenever the equipment so labeled is available. The Contractor (should any equipment be installed without the proper UL label) shall bear the entire cost of correction to the satisfaction of the authority having jurisdiction.

2.3 SUBSTITUTIONS AND SUBSTITUTE EQUIPMENT

A. Substitute equipment is encouraged if it is truly an equal to the specified items.

1. The designer has taken time and effort to analyze, evaluate and prove to himself that the specified unit will perform the function needed, wherein it is placed. This means the responsibility for the function of the specified equipment rests with the designer, who knows and understands what is to be accomplished.
2. If a **supplier** and/or the **contractor** desires to substitute equipment in place of specified item, he may do so, but he takes upon himself or herself the **full responsibility** that the substituted equipment will equal all of the performing characteristics, functions, etc., and/or exceed the performance of the specified item. The substitute equipment shall be of such a physical size and weight that it will mount in the designated location without alterations to the building and the structure will carry the load. If for any reason the substituted equipment requires alterations or modification, in any form to the building and/or the structure, the costs shall be paid by the contractor and/or those requesting the substitutions.
3. Those interested in requesting a substitution shall state the Manufacturer's catalog numbers and descriptions to establish the quality of product required. **Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Engineer eight (8) working days prior to day of bidding. The application shall include the following:**
   a. **A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents;**
   b. **The specified and submittal catalog numbers of the equipment under consideration;**
   c. **A pictorial and specification brochure.**

B. Because of the short bidding period, (from issuance of drawing to bid date), between the substitution request and the bid date, the designer does not have adequate time to make a full evaluation of substitute equipment. Therefore, **those requesting the substitution** must accept **full responsibility** for the items being submitted for substitution (operating characteristics, physical size, weight, output, not increase the load, etc.). If at any time during the course of construction, **even up into the final completion,** if the designer finds the equipment does not meet the design criteria, comply with the performance, etc., **those requesting the substitution and the contractor have the responsibility to remove the substituted equipment and install the specified item at their expense.** There shall be no cost assessed to the owner and/or the designer and **the replacement will not delay the completion of the project.**

Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents, nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specification, or find discrepancies therein, shall bring this to the attention of the Engineer, who will issue interpretation and/or additional instruction to Bidders before the project is bid.

C. Any **conflict** arising from the use of **substituted equipment shall be the responsibility ofthe contractor,** who shall bear all costs required to make the equipment comply with the intent of the contract documents.

D. **Samples** may be required for non-standard or substituted items before installationduring construction. Provide all samples as required.

E. **No materials or apparatus** may be substituted after the bid opening, except where the equipment specified has been discontinued. This substitution may be made by a change order.

F. Approved equipment shall be so noted, in writing in a formally issued **ProjectAddendum.**

2.4 INCENTIVE BIDS AND UNIT PRICES

A. Suppliers of materials, equipment, and systems are encouraged to submit incentive bids by grouping several products under one bid. However, at the request of the Architect and/or Engineer, the supplier shall submit a unit price to add or delete a particular unit, (panel, light fixture, fire alarm panel, etc.) from the quotation so that other components might be considered in the bid.

2.5 SPARE PARTS

A. Provide spare parts (fuses, overload heaters, diffusers, lamps, etc.) as specified. Transmit a list indicating all spare parts to Owner’s Representative prior to substantial completion. Submit copy of transmittal letter to Engineer.

B. Thermal Overloads: Provide one spare set of thermal overload heaters of each type used in the magnetic starters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.

B. Since the drawings of floor, wall, and ceiling installation are made at small scale, outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.

C. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.

D. All electrical networks, power, auxiliary, etc., systems shall be installed in conduit; see Section 260533.

E. Where conduit, outlets or apparatus are to be embedded in concrete, they shall be located and secured at the defined point. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.

F. Provide block-outs, sleeves, demolition work, excavation, etc., required for installation of work specified in this Division. Opening shall be core drilled and/or saw cut and shall be no longer than required. Seal around conduit and on equipment inside and out with a silicone compound.

G. Roof Flashing: Where raceways penetrate roofing or similar area, provide 26 ga. galvanized iron roof jack, sized to fit tightly to raceway for weather tight seal, and with flange extending to a minimum of 9 inches under roofing on all sides. Coordinate all work with roofing contractor.

H. Patching and Repair

1. The Contractor is responsible for all block-outs, demolition, patching and repair of all finished interior and exterior surfaces pertaining to the installation of this particular phase of work. All surfaces shall be finished (textured, painted, etc.) to match the adjacent materials.
2. Hard Surfaces: Whenever demolition or excavation is required for the installation of the electrical system, it should be the responsibility of the Contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, etc.
3. Lawn replacement is also included as a part of this section.
4. The method of patching and repair should follow good construction practices. All surfaces shall match materials and finish wherein the demolition occurred when construction is complete.

I. All electrical powered equipment specified on this project, whether specified in the architectural, mechanical, or electrical specification, shall be electrically connected and made operational. Confirm voltage, amperage, and phases.

3.2 COMPLETION OF WORK AND TESTING

A. Before energizing any circuits, make megger ground tests on conductors, bus duct and fused disconnects with the distribution breakers open. These readings shall be recorded by circuit number identification and submitted in triplicate to the Owner's Representative before the system is energized.

B. Before final inspection, but after the electrical installation is complete, the Electrical Contractor shall remove neutral grounding connection from main distribution panel and demonstrate to authority having jurisdiction and Owner's Representative, with an ohmmeter, that the electrical system neutral is grounded through main panel location only. Neutral shall be reconnected after the test is complete.

C. Emergency Power System: In the presence of the Owner's Representative, test the emergency power system, in its entirety, by transferring from normal to emergency power no less than six times to prove proper operation of all equipment, devices, light fixtures, etc. that are powered by this system. If a power pack is used, the factory representative should be present during the test. Write a letter to the Owner's Representative confirming the conditions of this test.

D. High potential tests per I.P.C.E.A., shall be made on all high voltage conductors after installation. A written report of same shall be made in duplicate to the Architect.

E. Test Equipotential grounding system throughout the building and report the results.

F. Auxiliary Systems - 27 & 28 Each system defined in Contract Documents shall be made operational by the factory representative. The Factory Representative shall confirm the operation of each component (speaker, stand by power, etc.) and report in writing(triplicate) his confirmation of the systems status of operation.

3.3 FINAL REVIEW

A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

3.4 PROJECT FINALIZATION AND START-UP

A. Upon completion of equipment and system installation, notify equipment Factory Representative and Subcontractors for system start-up.

B. Each Factory Representative and Subcontractor shall assist in start-up to examine their respective system and remain at the site until the total system operation is accepted by the Owner's Representative.

C. The Factory Representative and/or System Subcontractor shall give personal instruction on operation and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:

1. This is to certify that the Factory Representative and/or System Subcontractor for each of the systems installed below have performed start-up and final check out of their respective systems is satisfactory.

D. System Operating Report: After the facility has been in operation for 10 days, submit with a letter of guarantee a triplicate record of a voltage reading and ammeter reading on each phase of the feeder for the main and all branch panels, motors, outside lighting, etc. to the facility (these readings shall be taken with all equipment operating). A second report shall be made on equipment that has a load over 20 Amp 1-pole in the mechanical room, kitchen, shops, etc. when in operation.

1. This dated system operating report shall be submitted to the Owner's representative for distribution to the engineer and a copy placed in each maintenance manual.
   a. Electrical Load Readings

Demand_____	kw	Panel D_____	Amp
Panel A_____	Amp	Panel L_____	Amp
Panel B_____	Amp	Panel R_____	Amp
Panel B1_____	Amp	Panel MDP_____	Amp
Panel C_____	Amp		

   etc. identify and record the load on each panel and motor loads 3/4 hp and larger.

2. If there are any abnormal conditions, they shall be brought to the attention of the Engineer in writing as a part of this submittal.
3. Submit with the load readings for the motors, a list of motors with the size of overload heaters used for each motor. This includes thermal switches.
4. As a part of this document, submit a copy of each Auxiliary Systems test reports (Telephone, Fire Alarm, Sound, Data, etc.) with the proper signatures (See 3.2F).

System	Factory Representative
(List Systems Included)	(List name and address of Factory Representative)

5. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system (See 3.4C).

_____ _____
Owner's Representative Contractor or Electrical Foreman

6. Report that each emergency luminaire has proven operational by killing the circuit and visually confirming the luminaire illuminates (See 3.2G).
7. The Owner's Representative has received and accepted all spare parts as heretofore required by contact (See 2.5).
8. Submit mega OHM, equipotential, and high potential test reports (See 3.2A,3.2D, 3.2E).
9. Send copy of acceptance to Architect/Engineer.

END OF SECTION 26 0501

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SECTION 26 0508 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 MATERIALS AND METHODS

A. Materials and methods common to this project are listed below and shall be followed as closely as practicable using acceptable construction practices and specified products. This section indicates conditions and practices that should become a part of this project.

1. Materials: The materials installed on this project shall be new, noted in this specification and shall be installed in the course of construction, except, if they are changed in writing over the signature of the designer.
2. Method: The method of installation shall follow current acceptable electrical practices under the direction of a licensed journeyman electrician. This will be further explained in the body of the specification.
3. Notes: The notes on the plans are a part of the contract documents

1.2 EQUIPMENT CONNECTIONS

A. The Contractor shall install an electric service to the subject project as shown on the plans and described herein.

B. Extent of electrical connection for equipment includes final electrical connection of all equipment (supplied under this or any other division or by the owner) having electrical requirements. Make final connections for all owner furnished equipment. See other applicable Divisions of specification for building, namely, mechanical, plumbing, temperature control wiring requirements, kitchen equipment, etc.

C. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment.

D. Refer to Division-23 section for control system wiring; not work of this section, except as noted on the electrical plans.

E. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

A. CODE COMPLIANCE: Comply with applicable portions of NEC, state, and local codes as to type products used and installation of electrical power connections.

B. UL LABELS: Provide electrical connection products and materials which have been UL-listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL

A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to; raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. See Section 260533, Conduit Raceways; Section 262726, Wiring Devices; and Section 260519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:

1. Permanently installed fixed equipment - flexible seal-tight conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.
2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).
3. Other methods as required by National Electrical Code and/or as required by special equipment of field conditions.

END OF SECTION 26 0508

SECTION 260510 - EXISTING FACILITIES AND EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Existing facility, whether standing alone or an addition to a standalone, or if the existing building is a part of a new facility, the bidder shall consider the existing unit a part of this project. All electrical equipment, panels, apparatus, luminaires, conduit/conductors, boxes, devices, etc., are to be removed, reworked, added to, extended, etc., as noted on the contract documents to make a complete and operable facility. The contractor shall also include in his bid an allowance to cover items that may be concealed in wall, ceiling, or floor, that must be rerouted, relocated, etc., to maintain or extend existing systems to keep them operable.

B. When the project is completed all systems, apparatus, etc., shall be made operable and left in normal operating order.

1.2 EXISTING EQUIPMENT

A. General: The electrical conditions in the existing facility are part of this project, and all costs, changes, extensions, additions, etc., pertaining thereto shall be included in the base bid.

B. Disconnect all equipment that obstructs and/or is to be relocated. Reconnect when reset.

C. The new electrical equipment and apparatus shall be coordinated and connected into the existing system as required. Auxiliary systems shall comply unless otherwise specified.

D. The new luminaires indicated for existing outlets shall be installed in accordance with the luminaire specifications. New Conductors shall be installed from the panel to each existing outlet.

E. Conduit and wire installed in existing structures shall be concealed. Exceptions shall be an approval of Architect. (See demolition and patching sections).

F. When conduit is to be installed below concrete, etc., the surface shall be cut, not ripped up, with a backhoe or other equipment, but shall be mechanically cut then removed.

G. All electrical equipment and apparatus in the building not remodeled shall be connected asper specifications and left in working conditions.

H. Existing raceways shall be used where possible, except as noted.

I. New conductors shall be installed throughout the project. This includes main and branch feeders and all branch circuit wiring in remodeled areas where changes and/or additions are being made.

J. All vacated or unused power, communication, signal, control wiring or cabling, etc., shall have wire pulled out of conduit back to branch panel or the first active outlet. The conductors/cabling become the property of the contractor and shall be removed from the site.

K. Any and all equipment having electrical systems (power, auxiliary, etc.) That require disconnecting and reconnection, at the same or another location throughout the course of construction, shall be included as part of this contract.

END OF SECTION 260510

SECTION 26 0515- ELECTRIC SERVICE CONNECTION

PART 1 - GENERAL

1.1 ELECTRICAL SERVICE SYSTEM

A. Provide, install and coordinate an electric service to the facility as shown on the drawings and specified herein.

B. The Contractor shall contact Northwestern Energy relative to the installation of this electric service. **The owner will pay any costs assessed by the serving utility to provide electric service.** The electrician shall install service conduit from utility service point to transformer and from transformer to meter. Provide and install transformer pad, vault, meter section (Eusorc if required), etc., per power company specifications. Confirm the location of the point of service.

C. The service conduit shall be installed as stated in the contract document, confirm size with the serving utility.

D. Provide and install the service metering equipment, shown on the plans and/or required by the serving utility, and/or as specified in the contract documents.

E. Construction Lighting and Power is a part of the General Conditions.

F. Permanent power shall be connected as soon as the main service and panel are installed.

G. Service feeders installed in PVC and/or RMC (see Section 260533) shall be shrouded with Red 5-bags concrete 3" minimum cover with #3 rebar at all corners.

H. Phase Rotation: When the permanent service has been established, the contractor shall check the rotation of all motors and confirm proper rotation. Each motor shall have a correct rotation. Any costs arising from a reversed motor shall be the Electrical Contractors.

1.2 SERVICE CONNECTIONS

A. Provide and install the lugs, cable, labor, etc. necessary for the connection of the service power and/or transformers for the project.

1.3 MAKING ELECTRICAL CONNECTIONS

A. Make electrical connections to all equipment provided under Divisions 21, 22, 23, 26, 27 and/or 28, as it was shown on either the mechanical or electrical plans. The connection shall be in accordance with connector manufacturer s written instructions and with recognized industry practices and complying with requirements of NEC and NECA s "Standard of Installation" to ensure that product fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordancewith equipment manufacturer s written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with equipment installation

work.

D. Verify all electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings in writing to Architect before proceeding with rough-in work.

E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Confirm the rotation of all electric motors when making the final connection. Motors running in the reverse direction are the responsibility of this contractor.

G. Refer to basic materials and methods Section 260519, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 26 0515

SECTION 26 0519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors (600V)

C. Applications for conductors and cables required for project include:

1. Feeders
2. Branch Circuits

1.2 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables which have been UL-listed and labeled.

B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.

C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

D. Non-approved materials.

1. AFC Cabling
2. Non-metallic sheathed cable.
3. Service entrance cable.

1.3 SUBMITTALS

A. FIELD TEST DATA: Submit test data in accordance with IEEE Standard 400-1980 showing ambient conditions, voltage levels, level durations, and conduction current for each step. Include effective insulation resistance in submittal.

PART 2 - PRODUCTS

2.1 COPPER CONDUCTORS (600V)

A. All conductors shall be copper with 90% conductivity.

B. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated foreach service. Where not indicated provide.

C. Proper selection to comply with project s installation requirements and NEC standards. Provide conductors in accordance with the following:

1. Distribution and Panelboard Feeders; and other conductors, #2 AWG and larger shall be Copper; see drawings for size.
2. Conductors: All conductors shall be jacketed with THHN or XHHW insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG. Provide stranded conductors for #10 AWG and larger. Provide THHN insulated conductors (in dry areas) from outlets to luminaires, and in luminaire channels.
3. Conductor ampacity shall comply when local codes have a derating factor because of ambient temperature.
4. Provide color and coding of conductors as follows:
   a. Conductors
      1) All conductors shall be stranded copper wire, #12 AWG & #14 AWG may be solid copper. Color code all 208-volt wiring using black for phase A,red for phase B, blue for phase C, white for neutral and green for equipment ground.
      2) Color code all 480-volt brown for phase A, orange (purple) for phase B, yellow for phase C, gray for neutral, and green for equipment ground. A green ground shall be pulled in every conduit - see Grounding.
   b. Motor Control

1)	Motor Feeders	Black
2)	Hot or Stop Lead	Red
3)	Start Lead	Blue
4)	Common	White
5)	Indicating Light	Orange
6)	Interlock or Shunt	Brown
7)	Ground	Green

   c. Isolated Ground
      1) In all distribution feeders to panels having an isolated ground bar, install an insulated #8 green with orange stripe isolated ground conductor in that feeder conduit.
      2) In all branch circuits powering an IG receptacle, install #12 or insulated green with orange stripe isolated ground conductor. (See General Cable Co.)

2.2 AUXILIARY CABLES

A. The contractor shall provide and install a cable from each auxiliary system in fuel islands as noted on Sheet E-1.1.

2.3 CONNECTING BLOCKS (Also see Section 260520)

A. Taps made to conductors in wireways, switchgear, J-Boxes, etc. larger than #10 shall be made with an insulated connector. The connector block shall be an alloy that is completely compatible with copper, aluminum alloy 6061-T6 conductive plating for low contact resistance, excellent anti-pull out ability and set-screw for Suring in place. The block shall be insulated with a molded high dielectric plastisol that will not support combustion, abrasive and chemical resistant. All connections shall comply with rated for 600 volts 90"C and comply with NEC 100. Torque each lug to the recommendations of the manufacturer.

B. The unit shall be NSI Series NSZ (in and out same side), other types are: Series IPL (double row), Series IT (in and out), Series IPLD (pass through), etc. The contractor shall decide which type of connection is best suited for installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide #10 AWG conductors for all LED luminaire home runs.

B. Conductor size noted in panels is for the homerun. The conductor may be changed to code size after the first apparatus.

C. Parking Lot conductors shall be installed of the size noted until a change is indicated. Minimum size #10.

D. "G" in the Conduit symbol, denotes a #10 (or larger) green ground, which shall be installed in the conduit with other conductors. It shall connect to the ground bar in the panel.

E. GENERAL: Install electrical conductors and cables as indicated, in compliance with manufacturer s written instructions, applicable requirements of NEC and NECA s "Standards of Installation", and in accordance with recognized industry practices.

F. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.

G. Use pulling compound or lubricant, where necessary; compounds must not deteriorate conductor or insulation.

H. Keep conductor splices to a minimum in a J-box.

I. Install splices and tapes which have mechanical strength and insulation rating equivalent-or-better than conductor.

J. Isolated Ground - Install a yellow insulated #8 isolated ground conductor in all feeder conduit connecting the main ground to isolated ground bars in the branch panels.

K. Isolated ground Conductor Install a yellow with green or orange stripe #12 conductor in all branch receptacle "home run" conduit. Connect the conductor to the isolated ground terminal in the panel and the IG terminal on the convenience outlet. If there is no IG receptacle leave eight (8) inches of conductor in the device box for a future connection. If the IG conductor carries on to the next receptacle leave an 8" loop in the device box.

L. Use splice and tap connectors which are compatible with conductor material.

M. The conductor ends shall be stripped at the ends to comply with the following chart:

1. Strip Length Chart

CONNECTOR SIZE	LENGTH (inches)
500	2
350	1.75
250	1.625
3/0	1.437
1/0	1.25
#4	0.875

2. All conductor connections on lugs, breakers, connection blocks, etc. of the set-screw type shall be set with a torque wrench in strict accordance with industry standards as recommended for each conductor size.
3. Lug Torque Chart

CONN SIZE	500	350	250	3/0	1/0	#4
AWG/MCM WIRE SIZE	TIGHTENING TORQUE, INCH POUNDS					
500	375					
400	325					
350	325	325				
250	325	325	325			
4/0	325	325	325			
3/0	250	250	250	250		
2/0	180	180	180	180		
1/0	180	180	180	180	180	
3-2-1	150	150	150	150	150	
#4 - #6	110	110	110	110	110	45
#8	75	75	75	75	75	40
#10 - #16	75	75	75	75	75	35

N. **Vertical Support:** Conductors rising vertically shall be supported with conduit kellems grips or equal, in accordance with NEC section 300-19.

Cable Vertical Support Spacing	
Conductor Size	Minimum Distance - Feet
12 - 1/0	100
2/0 - 4/0	80
4/0 - 350 KCM	50
500 KCM	40

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test cable and wire for continuity of circuitry, and also for shortcircuits. Correct malfunctions when detected.

B. Check and prove the proper phase rotation of all rotating equipment powered by this network.

C. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements. (SEE SECTION ON COMPLETION ANDTESTING)

END OF SECTION 26 0519

SECTION 26 0522 - HEAT CABLE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide and install self-regulating heat cables, as noted on the plans.

B. Furnish and install heating cable system for roof drains in down spouts or rain gutters as described in Contract Documents.

C. The cable lengths shown in the schedule are approximate. The contractor shall bring the cable to the site and field cut the cable in lengths required to accomplish the intent of the plans.

D. Related Sections - 260501 Electrical General Provisions.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Cable

1. Chromalox - TW6-CR
2. Easy Heat - SMZH8-1-CBR 120 volt
3. Raychem - GM-1X Series
4. Thermon - RGC-1

B. Temperature and Moisture Sensitive Controller

1. Chromalox - GIT-2B
2. Easy Heat - GIT-2B
3. Raychem - GIT-2B
4. Thermon - GIT-2B

C. Heat Cable Controller as Specified in Drawings

2.2 APPROVED MANUFACTURERS

A. Chromalox, Murfreesboro, TN (866) 736-6686

B. Easy Heat, New Carlisle, IN (800) 537-4732

C. Raychem Corporation, Menlo Park, CA (800) 542-8936

D. Thermon Manufacturing Co, San Marcos, TX (800) 782-7653

E. Technitrace – Novatrace Zone Industrial

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall install grounding type plugs on one end and a termination on the other. The cable shall be grounded and safe.

B. Install moisture probe for controller in north facing rain gutter.

C. Install temperature sensor on roof.

D. Terminate raceway on exterior of building at heat cable location with weatherproof junction box.

E. Use only factory prepared, UL recognized splice and termination kits.

END OF SECTION 26 0522

SECTION 26 0526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide grounding as specified by NEC, as noted herein, and as indicated on drawings. Types of grounding in this section include the following:

1. Underground metal water piping
2. Grounding electrodes
3. Service equipment
4. Enclosures
5. Systems
6. Equipment
7. Isolated ground conductors
8. Other items indicated on drawings

B. "G" in the conduit symbol denotes a green ground (to match indicated conductor sizes) which shall be installed in the conduit with other conductors. It shall connect to an insulated ground bar in the panel. (Exception: Main Panel terminations made on ground bar bonded to enclosure).

C. “G” in all conduit, apparatus, equipment, etc. outside the building denotes a #10bare ground interconnecting all outside equipment having an electrical connection.

D. A green ground conductor shall be installed in all non-metallic conduit runs.

E. Install isolated ground conductors as indicated on the plans.

F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

1.2 QUALITY ASSURANCE

A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products which have been UL listed and labeled.

1.3 SUBMITTALS

A. None required.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation.

B. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

C. Isolated Ground Conductors (Ref. 260519-2.1,4 (C))

1. Between Panels - Insulated No. 8 (green w/yellow stripe).
2. Between Panel and Device - Insulated No. 12 (green w/yellow stripe).

D. Install an insulated ground bar in branch panels.

2.2 ELECTRICAL GROUNDING CONDUCTORS

A. Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC.

B. When conductor sizes are increased due to voltage drop (i.e., distance) the ground size shall be increased proportionately in size per NEC.

2.3 GROUND RODS (ONLY AS REQUIRED BY LOCAL CODE)

A. GROUND RODS: Steel with copper welded exterior, 5/8" dia. x 8 ft (quantity as per Code).

PART 3 - EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.

B. Install braided type bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.

C. Install clamp-on connectors only. Thoroughly clean metallic contact surfaces, to ensure electrical conductivity and circuit integrity.

D. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All non-metallic raceways shall include copper grounding conductor sized in accordance with NEC.

E. Provide a continuous service entrance ground conductor that interconnects the major ground points, namely ground rods (quantity of two, driven exterior to building), by means of bonding to water main, and by means of bonding (**Cad-Weld**) to building structural steel. If the conductor is not continuous each joint shall be **Cad-Welded**. The **Cad-Weld** constitutes a continuous conductor.

F. In addition to all cold water and ground rods provided to meet this specification, each location grounded to water main or ground rod shall have a Concrete Encased Electrode (UFER) ground. This Concrete Encased Electrode (UFER) ground shall consist of a minimum of 20 feet of No. 4 AWG bare copper cable (or per local code) embedded in concrete (feeder encasement, footing, floor slab, etc.) so that all portions of the cable are between 2" and 4" from the earth and with the center of the cable bonded to the ground rod or pipe.

G. Provide grounding conductors for dimming systems in accordance with manufacturer□s requirement.

H. All luminaire poles shall be grounded with a No. 10 stranded green ground.

I. See drawings for additional grounding requirements.

END OF SECTION 26 0526

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SECTION 26 0529 - CONCRETE PLATFORMS AND BASES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section relates to providing and installing concrete supports, bases, etc., as indicated for the service needed for the power conduits, panel bases, pole bases, service transformer pad, etc as an electrical equipment.

B. All code conditions related here to shall be enforced.

C. Buried conducts shall be shrouded with “red” concrete and shall be placed on virgin and compacted fill to prevent settling. Conduit shall be grounded to allow conduit to drain to a low point. If the low point is at a vertical elbow drill a 1/2(0.5)" ø hole at the low point in the elbow to drain all water. At that point provide a 12x12x12 gravel bed to receive the water

D. When stated install encase service conduit in a red 5-bag mix concrete. The concrete shall shroud the conduit a minimum of two inches on all sides. Depth of conduit shall be 48" or as per code.

E. All service feeders shall be located by placing a plastic **High Voltage Ribbon** in the fill, 12 “above (or as per code) the conduit run, for location at future evacuation.

F. Provide and install concrete bases as noted on the plans.

1. Concrete bases below panels shall be of the size noted on the plans, to raise the panel off the floor to eliminate water problems. The concrete shall be 5-bag mix with a finished to match the floor.
2. All concrete bases (light poles, bollards, etc.) shall be of a type and size to carry the load installed thereon. The concrete shall be 5-bag mix with rebar as indicated. The base shall have a smooth hand rub sand finish.

1.2 EXECUTION

A. The installation of each system and/or parts and pieces shall follow good journeyman practices and code conditions.

END OF SECTION 26 0529

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SECTION 26 0533 - RACEWAYS FOR ELECTRICAL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of raceway work is indicated by drawings and schedules.

B. Types of raceways in this section include the following:

1. Electrical Metallic Tubing (EMT).
2. Flexible Metal Conduit.
3. Intermediate Metal Conduit (IMC).
4. Liquid-Tight Flexible Metal Conduit.
5. Rigid Metal Conduit (RMC).
6. Rigid Non-Metallic Conduit. (below grade only w/RMC elbows)

C. Prohibited Raceway Materials:

1. Aluminum Conduit.
2. Electrical Non-Metallic Tubing (ENT).
3. Armored Cable Type AC (BX) Cable.
4. Metal-Clad Cable Type MC Cable. (Lengths greater than 96")

D. Prohibited Fitting Materials:

1. Crimp-on, Tap-on, Indenter Type Fittings.
2. Cast Set-Screw Fittings for EMT.
3. Spray (aerosol) PVC Cement.

1.2 QUALITY ASSURANCE

A. MANUFACTURERS: Firms regularly engaged in the manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

C. MINIMUMS: Minimum, conduit sizes shall be as per NEC Tables 3A, 3B, and 3C or as shown on plans. Minimum home run size shall be 3/4". Electrical contractor shall not modify the wiring arrangement without prior approval from Engineer.

1.3 SUBMITTALS

A. Not required.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. GENERAL: Provide metal conduit, tubing and fittings or types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

B. Data/telephone conduit shall be installed as shown with 1" being the minimum size.

C. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.

1. EMT FITTINGS: Provide and install set-screw type malleable steel fittings: connectors shall be insulated throat type, concrete tight where required by application. Install OZ Type B bushings on conduits 1-1/4" and larger.
   a. Provide red EMT for Fire Alarm System (Allied “Fire Alarm E-Z Pull” or equivalent).

D. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type:

1. Zinc-coated steel.
2. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1 Class 1, and Style A.

E. INTERMEDIATE METAL CONDUIT (IMC): RS 22-C-581.

1. INTERMEDIATE STEEL CONDUIT FITTINGS: Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at conduit terminations, us OZ Type B bushing on conduits 1-1/4" and larger.

F. LIQUID-TIGHT FLEXIBLE METAL CONDUIT: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible, continuous interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC). Type UA and/or NMLT-B non-metallic.

1. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G and/or fittings to match the specified non-metallic conduit noted above.

G. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.

1. RIGID STEEL CONDUIT FITTINGS: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible, continuous interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC). Type UA and/or NMLT-B non-metallic.

H. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSIC08.1 and NEMA Std. Pub. No. RN1.

1. PVC EXTERNALLY COATED RIGID STEEL CONDUIT FITTINGS: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible, continuous interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC). Type UA and/or NMLT-B non-metallic.

I. EXPANSION FITTING: OZ Type AX, or equivalent of suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS (Below grade only, shroud with concrete where indicated).

A. GENERAL: Provide non-metallic conduit, ducts, and fittings of types, sizes and weights (wall thicknesses) as indicated shall not be installed inside the building, except it be encased in concrete and surfaces through a RMC elbow; with minimum trade size of 3/4". In this specification, it is not permitted above grade for any reason.

B. UNDERGROUND PVC PLASTIC UTILITIES DUCT: ANSI/NEMA TC 6, Type 1 for encased burial in concrete, Type II for direct burial.

1. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS: ANSI/NEMA TC9, match to duct type and material.
2. CONDUIT, TUBING, AND DUCT ACCESSORIES: Provide conduit, tubing and duct accessories of types, sizes, and materials, complying with manufacturer S published product information, which mate and match conduit and tubing.

C. SEALING BUSHINGS: Provide OZ Type FSK, or FSKA.

D. SPECIAL GROUND: To maintain the building ground continuity, a NEC size ground shall be installed in each non-metallic conduit run, where the system voltage is greater than 48-volts.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. Install electrical raceways where indicated; in accordance with manufacturer S written instructions, applicable requirements of NEC, NECA "Standard of Installation", and in accordance with the following.

B. FEEDERS UNDER 600 VOLTS: Install feeders to panels, motor control centers and individual equipment feeders rated 100 amps and greater, in rigid metal conduit (RMC), or intermediate metal conduit (IMC) except where buried below grade, install in non-metallic conduit or duct. Feeder conduits 1-1/2" round and larger shall be encased in concrete as a part of the floor. Install conduit just below the floor with the top of the conduit touching the bottom of the slab and the bottom of the conduit being covered with at least 1" of concrete.

C. Outside feeders below grade shall be installed in RMC and/or PVC conduit shrouded with a minimum of 3" cover of red concrete with a #3 rebar in opposite corners. The top of the duct bank shall be set 48-inches below finish grade.

D. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS: Install in electric metallic tubing (EMT); except in poured walls, floor slabs, below concrete slab-on-grade, or in earth fill. Conduit installed in before mentioned areas shall be non-metallic plastic duct. Encase non-metallic plastic duct 1-1/4" and larger in concrete.

E. Coordinate with other work, including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.

F. When non-metallic conduit is used it shall come to the surface in a RMC elbow or box.

G. Install raceway in accordance with the following:

1. Provide a minimum of 12" clearance from flues, steam and hot water piping, etc.
2. Conceal raceways in finished walls, ceilings and floors (other than slab-on-grade). Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines.
3. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway.
4. **Flexible raceways shall not be concealed in construction and where installed the run shall be limited to 4 feet in length.**
5. Comply with NEC requirements for installation of pull boxes in long runs.
6. All raceways shall terminate in a connection and/or bushing.

H. Install all control conduit for Divisions 22 and 23.

I. When a Fire Alarm System is required, Install Fire Alarm Cable/Conductors above grade in red fire alarm conduit (See 2.1-C (1)(a)).

3.2 NORMAL INSTALLATIONS

A. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandril and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.

B. Replace all crushed, wrinkled or deformed raceway before installing conductors.

C. Provide rigid metal conduit (RMC) for all bends in buried conduit greater than 30 degrees. Provide a protective coating for RMC bend as specified herein.

D. Where raceways penetrate building or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 ft. on the exterior side of the floor or wall. Provide OZ, Type FSK or WSK sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering building or vaults below grade.

E. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.

F. Install five spare 3/4" conduits (capped) from each flush branch panelboard into accessible ceiling and floor space. Where the floor is not accessible run ten conduits into accessible ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.

G. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.

H. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.

I. All conduit that penetrates the roof shall be flashed with a factory jack, see Section 260501/3.1 (F).

J. Underground runs of conduit greater than 160 ft. shall rise out of concrete with rigidmetal conduit elbow and riser.

K. All overhead conduit supported within 1-1/2" of metal roof deck shall be installed in rigid metal conduit. (NEC 300.4 (E)).

L. All conduit penetrating C-Store slab and subject to abuse, shall be rigid metal from the elbow below the slab to the floor penetration. PVC conduit may be installed below the slab from the rigid metal elbow to the panel.

M. All conduit installed in Class 1 Division 1 or 2 areas shall comply with NEC 514. Seal-offs are required as indicated on Electrical Sheet E-1.1 and per NEC 514.

3.3 GROUNDING

A. All metal conduit terminations shall be equipped with a grounding bushing.

B. To maintain the continuity of the building ground network, install a code size ground conductor in all non-metallic conduit.

3.4 FIRE PENETRATION SEALS

A. All penetrations through fire rated floors and walls shall be sealed to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after the fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. The sealant shall remain soft and pliable to allow for the removal and/or addition of cables without the necessity of drilling holes. It shall adhere to itself to allow any and all repairs to be made with the same material. It shall permit the vibration, expansion and/or contraction of raceways and/or cables going through the penetration without the seal cracking or crumbling.

B. When damming materials are to be left in place after the seal is complete, all such materials shall be non-flammable.

C. When sealant is injected into a penetration, the foam shall expand to surround all items within the penetration and maintain pressure against the walls of the penetration. The foam shall cure within five minutes and be fire resistant at that time. No heat shall be required to further expand the foam to block the passage of fire and smoke or water.

D. All wall or floor penetration opening shall be as small as possible.

E. The foam sealant shall meet all of the fire test and hose stream test requirements of ASTM E119-73 and shall be UL Classified as a Wall Opening Protective Device. The sealant shall be CHASE-FOAM CTC PR-585 Fire Resistant Foam Sealant from Chase Technology Corporation, Huntington Station, New York, 11746, or equals of 3M and T &B.

F. Escutcheon plates - when a conduit passes through a ceiling, wall and/or floor into a finished space, an escutcheon plate shall be installed on the conduit to cover the unfinished hole and sealant.

3.5 PROHIBITED PROCEDURES

A. Use of wooden plugs inserted in concrete or masonry units for mounting raceway, supports, boxes, cabinets, or other equipment.

B. Installation of raceway which has been crushed or deformed.

C. Use of torches for bending PVC.

D. Spray applied PVC cement.

E. Boring holes in truss members.

F. Notching of structural members.

G. Supporting raceway from ceiling system support wires.

H. Nail drive straps for supporting raceway.

3.6 EXCAVATION AND BACKFILL

A. RACEWAY INSTALLATION BELOW SLAB-ON-GRADE, OR BELOW GRADE:

1. The Electrical contractor is responsible for all excavation and backfill related to the electrical installation defined herein and/or as indicated on the plans.

B. UNDERGROUND RACEWAY AND CONDUIT:

1. Bury underground raceway installed outside building 24 inches deep minimum.
2. Wrap buried galvanized RMC and galvanized IMC conduit and fittings with vinyl tape where in contact with earth or concrete.
3. Opening of finished surfaces asphalt concrete, grass, etc. shall be accomplished by first identifying the limits of the opening then cut within the limits preserving the undisturbed areas. Asphalt shall be cut with a wedging tool, concrete with a diamond saw and grass with a cutter.
4. Excavation shall be accomplished with the proper equipment. Protective care shall be taken to not disturb the adjacent surfaces and materials. This contractor is responsible and shall protect all material objects and things adjacent to the excavation.
5. All materials not reinstalled in the installation shall be removed from the premise.
6. Backfill the first six (6) inch layer over the installed subject (conduit, cable, etc.) shall be sand. Subsequent six (6) inch layers shall be loam soil. Each layer shall be compacted to a 90% standard proctor test before the next layer is applied. (Refer to Section 260533, Part 3 for conduits required to be encased in concrete).
7. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. Install RMC (with protective coating) for raceways passing vertically through slabs on grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.

8. Apply protective coating to metallic raceways in direct contact with earth or fill ofany type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
9. Mark all buried conduits which do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
10. Conduits encased in concrete shall be shrouded with a 3" of Red concrete. Install a #3 rebar in opposite corners of the encasement except for two conduits or less where two #3 bars in opposite corners is acceptable.

C. RACEWAY INSTALLATION IN SUSPENDED SLABS:

1. Install conduit as close to the middle of concrete slab as practicable without disturbing reinforcement. Do not install conduits of diameter greater than 1-1/4" of the slab thickness. Space conduits not less than 3 diameters on center (except at stub up locations). Provide OZ expansion fittings at all expansion joints. All raceways shall be installed with concrete tight fittings.
2. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.

END OF SECTION 26 0533

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SECTION 26 0534 - BOXES, PULL BOXES, CONDUIT BODIES AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical box and electrical fitting work is indicated by drawings and schedules.

B. Types of electrical boxes, fittings, etc. in this section, or noted on the plans shall include the following:

1. Outlet boxes
2. Junction boxes
3. Ground boxes
4. Conduit bodies
5. Bushings
6. Locknuts
7. Knockout closures
8. Miscellaneous boxes and fittings

1.2 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134.1 (NEMA Standards Pub. No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings which have been UL-listed and labeled.

1.3 SUBMITTALS

A. None required.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. INTERIOR OUTLET BOXES: Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices; standard box shall be 4" square x 2-1/8" deep, (Raco 231) with 3/4" knock outs and tile or **masonry/type** box extensions (Raco 843).

B. If the structure will not allow a 4" square box, use a 3" deep single gang unit (Raco 695).

C. In spaces with restricted width, like between a door frame and window jam, use partition boxes (Raco 426).

D. INTERIOR OUTLET BOX ACCESSORIES: Provide outlet box accessories as required for each installation, including mounting brackets, hangers, masonry extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications. See the details on the plans.

E. WEATHERPROOF OUTLET BOXES: Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face application, with face plate gaskets and corrosion-resistant fasteners.

F. JUNCTION AND PULL BOXES: Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers. J-box larger than 8 x 8 x 6 shall have a hinged cover.

G. CONDULET BODIES (FITTINGS): Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

H. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable iron conduit bushings and offset connectors, or types and sizes to suit respective uses and installation.

2.3 GROUND BOXES

A. All ground boxes shall be mounted to be flush with the finished grade. (See architectural plans)

B. All J-boxes installed outside where access is needed shall be a composition type capable of withstanding the elements for an indefinite period of time. The boxes shall be rated for no less than 5,000 - lbs. over a 10" x 10" area and be designed and tested to temperatures of 50° F. The material compressive strength shall be no less than 11,000 psi. Provide a locking cover (Label electrical with bolt and locking mechanism) shall have a minimum coefficient of friction of 0.5. The boxes shall be stackable for extra depth if needed. The bottoms of the boxes are open and shall have a 6" layer of pea gravel in the bottom. The unit shall be of the size noted on the plans.

2.4 FITTINGS

A. The contractor shall provide **all sheet metallic** connectors, coupling, etc., as needed on this project.

B. When installing non-metallic sheathed cable, all connections to boxes, cabinets, etc., shallbe made with screw steel fittings with a locknut connection to the box.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface with other work.

B. Coordinate location of outlet for water cooler with Division 22 & 23.

C. Coordinate location of outlets adjacent to or in millwork with Division 06 before rough-in. Refer conflicts to Architect and locate outlet under his direction.

D. Coordinate with Division 23 for installation of exposed raceway in mechanical equipment areas. Exact separation of responsibility is shown on Drawings.

E. Mount switch boxes with long dimension vertical.

F. **Mount receptacle boxes with long dimension vertical**. See Detail 4/ED-1.

G. Boxes shall be accessible and installed with approved cover.

H. Do not locate device boxes which are on opposite sides of framed walls in the same stud space. In other types of wall construction, do not install boxes back to back.

I. Locate boxes so outlets are not obstructed by pipes, ducts, or other items.

J. Install outlets flush with finished surface and level and plumb.

K. Boxes for switches shall generally be located within 6 inches of door jamb.

L. Properly center single outlets in each room. Where two or more outlets occur, space them uniformly and in straight lines with each other.

M. Support switch boxes larger than two-gang with side brackets and steel bar hangers in framed walls.

N. HVAC Instrumentation and Control System:

1. Mount remote sensor outlet boxes with long dimension vertical.
2. Mount thermostat outlet boxes with long dimension horizontal.

O. Install electrical boxes and fittings where indicated, complying with manufacturer s written instructions, applicable requirements of NEC and NECA s "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

P. Minimum height of wall receptacles shall be 18". With the box arranged for vertical mounting of the receptacles (ground slot at the bottom).

Q. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

R. Provide cover plates for all boxes. See Section 260534, Wiring Devices.

S. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

T. Provide knockout closures or cap unused knockout holes where blanks have been removed.

U. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface so the device mounting flange sets on the box mounting plate. This will cause the device and cover plate surfaces to match.

V. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them.

W. Provide electrical connections for installed boxes.

END OF SECTION 26 0534

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SECTION 26 0548 - ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. All electrical equipment, distribution panels, motor control centers, conduit, device boxes, apparatus, etc., shall be securely anchored and/or supported in place as specified herein and/or in accordance with state, local, and seismic codes.

1. Work of this section includes supports, anchors, sleeves, and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hold conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, and all associated accessories.
2. Quality Assurance: Comply with NEC and local codes as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub. No. FB 1, “Fittings and Supports for Conduit and Cable Assemblies”. Provide electrical components which are UL-listed and labeled.
3. Manufactured Supporting Devices and Raceways: Provide manufactured mounting brackets (such as Caddy #SDG or SDB - D - 16); complying with manufacturer’s standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawing details for additional requirements.
4. Tie-wire is not acceptable.
5. Supporting of equipment may be noted in other sections of the specifications.

B. Wall supported equipment shall be mounted on an angle support bracket with anchors into or through the wall as perimeter (the latter mounting is preferred, but must be approved by the architect), with two 1/2" rods up to the structure from the outer most corners of the mounting frame tied-off to the building structure. This would be likened unto a transformer. Wall mounted electrical panels shall be mounted directly to the wall.

C. For hanging of conduit, see Section 260533.

D. Installation of Supporting Devices for all types of Raceways: Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer’s written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

1. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
2. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible.

3. RACEWAYS (ALL TYPES): Support raceways which are rigidly attached to structure at intervals not to exceed 8 feet on center and within 12" of each junction box, outlet or fitting. Support raceway (as it is installed) in accordance with the following:

NUMBER OF RUNS	MIN. 3/4" TO 1-1/2"	1-1/2" & LARGER
1	Full straps, clamps	Hanger or hangers.
2	Full straps, clamps	Mounting Channel or hangers.
3	Mounting Channel	Mounting Channel

4. Support suspended raceways on trapeze hanger system, or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use “tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.
5. Install electrical raceways where indicated; in accordance with manufacturer’s written instructions, applicable requirements of NEC and NECA “Standard of Installation”.
6. Coordinate with other work, including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
7. Coordinate the campus ground equipment installation with existing structures, trees, lawn sprinkler systems, etc.
8. Install raceway in accordance with the following:
   a. Provide a minimum of 12" clearance from flues, steam and hot water piping.

E. FLOOR MOUNTED EQUIPMENT: Provide rigid attachment of all floor mounted equipment to the floor slab or structural system. Provide 5/8" bolts or expansion anchors at each 90 degrees corner and at intervals not to exceed 48" on center along entire perimeter of the equipment. Provide rigid attachment for all floor mounted switchboards, panelboards, power and control equipment, motor control centers, dimmer cabinets, transformers, oil switches, battery packs and racks, and similar equipment furnished under Section 26.

F. BURIED CONDUIT: Conduit installed in the earth shall be laid on undisturbed soil and/or compacted fill. The first six (6) inches of cover shall be sand. See Excavation and Backfill - see Section 260533-3.6.

G. Concrete slabs, bases, curbs, etc., for electrical apparatus shall be provided and installed under this contract. The concrete shall be 5-bag mix, except as noted.

1. The contractor shall provide and install an 8 x 8 x 4 concrete base for the transformer (confirm size and depth with the service utility) at the indicated location.
2. Unless otherwise noted, provide a 4" high concrete base for all main panels, motor control centers, transformers, engine generators, etc. Extend base 4" beyond equipment or mounting rails on all sides or as shown on the drawings. Coordinate the pad dimension with the equipment to be located thereon.
3. Concrete pole bases (detailed on the plans) shall be provided under Division 26. Coordinate size and location of all bases and furnish all required anchor bolts, sleeves and templates as required to obtain a proper installation.
4. All concrete used on this project shall be 5-bag mix and/or as specified in the concrete section of the Architectural Section.

PART 2 - SEISMIC BRACING

2.1 GENERAL

A. The General Conditions, Supplementary General Conditions, Alternates and Addenda, Applicable Drawings and the Technical Specifications shall apply to all work under this division.

B. This seismic bracing section shall conform to the conditions governing the area within the structure being built under local and/or state UBC Seismic Requirements.

2.2 SCOPE OF WORK

A. The materials covered by these specifications consist of furnishing all labor, material and equipment necessary to complete the seismic bracing for all work provided under section 260000.

B. The work shall include all electrical isolated and non-isolated equipment, luminaires, raceways, etc.

2.3 CODES - REGULATIONS

A. In the installation of this work, comply in every way with the requirements of the laws, ordinances and rules of the system design and installation shall be based on seismic zone III of the Uniform Building Code, current edition and other standards listed below.

B. Reference Standards:

1. Uniform Building Code current edition, especially Sec. 2336
2. NFPA bulletin 90A, current edition
3. UL Standard 181
4. Tri-Services Manual, fagel etal 1978

C. If a conflict occurs between these rules and this specification, the rules are to govern. Accept this condition upon submitting bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the contractor from complying with any requirements on the plans or specifications which may be in excess of requirements of the hereinbefore mentioned rules and not contrary to same. Contractor shall bear all costs arising from the installation of any materials or equipment which is in conflict with the above-mentioned codes or ordinances.

D. Obtain approvals, inspections, etc., required by code. All fees shall be included in the contract price. The contractor shall furnish a certificate of approval to the Owner's Representative from the inspection authority at completion of the work.

2.4 MATERIALS AND WORKMANSHIP

A. All materials and equipment furnished and installed shall be first quality, new and meet the standards of NEMA, IPCEA, LS, UL, NFPA, UBC, UOSH, NEC, and shall bear their label wherever standards have been established and label service is available. Where materials and equipment are specified by manufacturer's name, and type and quality required is thereby denoted. The Owner's Representative shall be afforded every facility, deemed necessary to inspect and examine the materials and apparatus being installed to provide their quality, skill and competency of workmanship.

B. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner's Representative. Nothing contained herein shall relieve the contractor from making good and perfect work in all details of construction.

C. The contractor shall work in harmony with the Owner's Representative and with other contractors, companies or individuals working in connection with this project. Imperfections or errors by other contractors shall not relieve responsibility of this contractor. Store materials orderly and clean up without interference.

2.5 QUALITY ASSURANCE

A. The contractor shall be held responsible for purchasing and installing vibrator isolators, flexible connections, rigid steel frames, concrete inertia bases, anchors, inserts, hangers, and attachments, seismic bracing and snubbers as required for seismic control and prevention of the transmission of vibration for both isolated and non-isolated systems.

B. Manufacturers and suppliers approved for use by the contractors Mason Industries, Inc., Korfund, and Amber/Booth Company.

C. The approved manufacturer or supplier shall be totally responsible for the fabrication and operation of the seismic bracing components specified herein for all isolated equipment, non-isolated equipment, luminaires, raceways, etc.

2.5 GUARANTEE

A. The entire electrical system installed under this contract shall be left in proper working order and be in compliance with the drawings, specifications and/or authorized changes to the satisfaction of the Owner's Representative. Without additional charge, replace any work or materials which develop defects, except from ordinary wear, within one year from the date of substantial completion. A written guarantee covering the above provisions shall be signed and delivered to the architect after the project has final acceptance by the inspecting authority.

PART 3 - PRODUCTS

3.1 ISOLATED EQUIPMENT

A. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases. Each spring mounted base shall have a minimum of four all directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. The snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications.

B. Elastomeric, 50 durometer, materials shall be replaceable and a minimum of 3/4" thick. Snubbers shall be manufactured with an air gap between hard and resilient materials of not less than 1/8" and not more than 1/4". Snubbers shall be installed with factory set clearances.

C. The capacity of the seismic snubbers at 3/8" deflection shall be 3 to 4 times the load assigned to the mount grouping in its immediate area.

3.2 NON-ISOLATED EQUIPMENT, RACEWAYS, ETC.

A. All non-isolated equipment shall be installed according to current Uniform Building Code Sec. 2312 (g): Cp Factor Table 23J, I Factor Table 23K. In addition, the vertical forces, restraint requirements shall be computed as .5g the value of the lateral forces.

B. All non-isolated raceway shall be protected against seismic disturbances except as noted below:

1. All electrical conduit less than 2" inside diameter.

PART 4 - EXECUTION

4.1 SEISMIC REQUIREMENTS

A. All electrical work shall be braced, snubbed or supported to withstand seismic disturbances and remain operational. Furnish all labor, materials and equipment to provide protection against seismic disturbances and remain in place.

4.2 SHOP DRAWING SUBMITTAL AND REVIEW

A. Submit complete, bound submittal in a loose-leaf binder large enough for all items (8 copies) to architect after award of contract. All such submittals shall include, but are not necessarily limited to, the following:

1. Complete engineering calculations and shop drawings, prepared and stamped by a licensed engineer (UBC 302-6) for all seismic requirements for all equipment that is to restrain raceways, etc.
2. The type, size and deflection of each isolator proposed for items in this specification and on the drawings.
3. Details for all the isolators and seismic bracing with snubber proposed for items in this specification and on the drawings.
4. Details for steel frames and concrete inertia bases to be used in conjunction with the isolation of the items in this specification and drawings.

5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing and snubbers.
6. The size, loading and location of raceway supports with either a plan or complete description of the system.

B. All items must be submitted at the same time. Partial submittals will not be accepted. Binders and indexes will remain in possession of engineer, architect, contractor and sub-contractor.

C. Review is for assistance and interpreting the design concept. Changes in requirements will not be made in the review process. Review action does not exempt requirements to meet the intent of the contract documents. Any changes will be made by change order. Items not included in the submittal or incorrectly selected shall be in accordance with the contract requirements.

END OF SECTION 26 0548

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The Electrical Contractor is responsible for the labeling of all electrical equipment for this project. The labels shall be made on one-eighth inch laminated micarta and an engraving machine as stated below.

B. Labeling and Engraving: Any and all electrical control equipment shall be labeled with an engraved black Micarta with white core labels, 1/16" thick, shall be bolted on the interior and the exterior of branch panels (panel name and voltage) and the exterior of disconnect switches, motor controls, major J-boxes (power and auxiliary), push buttons, thermal switches, time switches and similar equipment. The labels shall have 1/4" high engraved letters, such as 1-1/2 HP FAN, PANEL - A. All main panel circuits shall be identified with Micartalabels.

C. The phase of each feeder conductor shall be **color coded** at each end in panels and junction boxes as stated in Section 260519 - 2.1. The feeder powers shall be attached to the bundle of cables with a tie-wrap.

D. Conduit shall be installed as diagramed on the plan. Any deviation shall be authorizedin writing prior to rough-in.

E. Write with a felt tip pen that contains permanent ink, on the inside of each device box and on the back of every plate, the circuit to which the device is connected. Example: Circuit "A-1".

F. Label the front of each convenience outlet/device with a self-adhesive label using black typewritten font with 3/16" high text. Tape shall be clear. Do not label switches.

G. Engraving device plates - see WIRING DEVICES.

END OF SECTION 26 0553

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SECTION 26 0913 - ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of this section is to provide and install special power monitoring as a part of the main panel. Incorporated in the main panel shall be a unit that reads and retains the electrical functions of the system, namely a Power Logic Panel, which shall be installed in conjunction with, and a part of, the main switchboard and/or power distribution systems, which will relate to the building operation for power analysis and service improvement.

1.2 QUALITY ASSURANCE

A. This equipment shall meet all of the NEC, NEMA, ANSI, IEEE, etc. standards that relate to this type of equipment.

1.3 SUBMITTALS

A. The manufacturer's detailed data shall be submitted for evaluation and approval prior to purchasing the equipment. Only stamped and signed submittal sheets will be used in ordering the equipment.

PART 2 - PRODUCTS

2.1 POWER LOGIC PANEL

A. The Contractor shall provide and install a Power Logic panel on main panel. The panel shall be connected into the service feeder and set-up to perform all of the functions listed below. Mount the unit in the main disconnect section in a manufactured enclosure, unless otherwise noted on the plans. Features to be accomplished are:

1. Full Instrumentation
2. RS-485 Comm Port
3. Front Panel Optical Comm Port
4. 0.2% Accuracy Class
5. Alarm/Relay Functions
6. On-board Data Logging
7. Downloadable Firmware
8. Date/Time for Each Min/Max
9. Waveform Capture
10. 12-Cycle Event Capture

B. The unit shall be as manufactured by Square "D" Company.

C. The installation shall be in strict accordance with the manufacturer's recommendations and shall be tested and made operative when the project is complete.

PART 3 - EXECUTION

3.1 GENERAL

A. The components defined in this section shall be installed in strict accordance with the manufacturer's recommendations and applicable sections of this specifications.

B. The power logic unit shall be installed in the main panel ahead of the distribution section and shall read the characteristics of the service power. All components required to make the unit operate shall be installed in their proper location and shall be electrically protected.

C. When the installation is completed on all items in this section of the specifications, the units shall be tested and information related thereto given to the owner's representative, who will also be schooled in the operation.

END OF SECTION 26 0913

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall provide and install the lighting controls as noted, which shall include the controls, accessories, boxes, etc., to make the installation complete and operable.

1.2 MOTION DETECTORS

A. The contractor shall provide and install adjustable timer (6-15 min.) motion detectors as noted on the plans. The detectors shall be complete with sensors, relays, (or power pack) enclosures, etc. for a complete installation.

1. The small room wall detectors shall be of PIR technology. The unit shall cover a semi-circular area of 35-ft and shall be mounted 48-inches A.F.F. It shall be Watt Stopper WS-200-120/277 for 120-volts. Two-pole units shall be PW-200-W.
2. The ultrasonic detector shown in corridors is for controlling the total corridor luminaires. It shall have a 10-ft. narrow beam for a range of 45-ft. on either side of the center line or a range of 90ft - see plan for layout. The unit shall be ceiling mounted spaced down to level with the bottom of any obstruction. It shall be Watt Stopper W- 2255 (direction oriented) with power pack. A power pack can serve up to 3 sensors.
3. A detector requires a power pack for power control. The contractor shall provide and install these components as a part of the contract. The power pack unit shall be Watt Stopper C120E-P or C277E-P. Provide double-pole contact for motion sensors controlling exhaust fans.
4. In lavatories, mount on the ceiling an advanced ultrasonic sensor that is omni-directional, Doppler technology. The unit shall control a power pack (double contact) that will control the lights and the exhaust fan. The unit shall be a Watt Stopper WT1100 w/Power Pack C120E-P for 120-volts.
5. Provide and install “power packs and slave relays” as needed, for each sensor as required. The power pack shall be installed in a J-box located in an accessible location. Note the final location of the power pack on the plans. The power packs shall be C120E- P and C277E-P for 120 and 277-volts, respectively.

B. The detector shall have been tested and completed 60,000 successful operations.

C. Hubbell, Lutron, Leviton, Tork, or Sensor Switch are approved equals provided they meet the specifications and functions of the named units’ criteria. If the substituted units do not perform all the functions, the contractor shall provide the named and/or specified equipment.

D. Submission: The contractor shall coordinate exact sensor location with manufacturer by submitting to the manufacturer a layout of the sensors for his review and evaluation. After the manufacturer has approved and endorsed the submitted plan, it shall be issued to the engineer as a shop drawing. The manufacturer shall provide the sensors as needed to perform the function and intents of the design.

1.3 LED LAMP DIMMERS

A. Provide branch lighting solid-state AC dimmer controls for LED luminaires; wattage and voltage as indicated, 60 hertz, with continuously adjustable slider control. Provide dimmers manufactured by Lutron. Color as selected by Architect.

1.4 LIGHTING CONTROL PANEL

A. The contractor shall provide and install lighting control panel with breakers as shown on the plans. Install bypass switch to override automatic control of exterior lighting. Bypass switch shall be installed on panel cover or adjacent to panel. Install a clear label with 3/16" high typewritten text “Exterior Lighting Bypass”.

END OF SECTION 26 0923

SECTION 26 2413 - ELECTRICAL SERVICE AND DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of this work is to install and connect a main service disconnect and distribution switchboard as indicated on the drawings. This panel will be provided by owner. Electrical contractor shall accept deliver on site and protect switchboard during construction.

B. Furnished switchboards shall be mounted on a 6” concrete curb and tied together as if it were factory installed as a single unit. The total unit shall be anchored to the pad at each corner - see Section 260529.

1.2 QUALITY ASSURANCE

A. Switchboard shall be UL listed and labeled. Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC pertaining to installation of wiring and equipment in hazardous locations. Comply with NEMA Stds. Pub. No. 250, “Enclosures for Electrical Equipment (1000 volt maximum)”. Pub. No. 1 “Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less”, braced for 100,000A SCA.

1.3 SUBMITTALS *TO BE PROVIDED VIA MAVERIK VENDOR”

A. PRODUCT DATA: Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.

B. SHOP DRAWINGS: Submit dimensioned drawings of main service disconnect and distribution switchboard with accurately scaled layouts of enclosures and required individual switchgear, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.

PART 2 - PRODUCTS

2.1 METER SECTION *COMPLIANCE BY MAVERIK VENDOR*

A. The vendor shall provide for installation by the electrical contractor, a meter base and/or section as shown on the plans. These sections shall be sized to the service conditions.

B. The serving utility has definite requirements for meter section to monitor the power used in this building. The vendor shall provide for installation by the electrical contractor, the utility required (EUSERC -when required) meter equipment. The vendor shall contact the utility company and confirm the units indicated on the plans. The contractor has the responsibility and shall provide the required equipment regardless of what is shown on the plans.

2.2 MAIN DISCONNECT AND SWITCHBOARD (EUSERC APPROVED WHEN REQUIRED) *COMPLIANCE BY MAVERIK VENDOR*

A. SWITCHBOARD: Floor standing, dead front, dead rear, with all bussing and equipment accessible from the front, constructed in accordance with the feeder diagram and approved shop drawings. Each section of the switchboard shall bear the Underwriters label and manufacturer's label and shall comply with all applicable codes and ordinances. Provide black and white bakelite nameplates identifying each function and each circuit breakers in the switchboard.

B. WHERE SPACES ARE INDICATED, BUSSES: Extended full length and complete with mounting holes and/or hardware for the installation of future equipment.

C. Pull section if specified shall be constructed like unto the distribution panel as to height, color, and finish.

2.3 DISTRIBUTION PANEL *COMPLIANCE BY MAVERIK VENDOR*

A. ALL CIRCUIT BREAKERS, SWITCHES, AND OTHER INTERIOR EQUIPMENT: Mounted to the framework and no equipment mounted to the front plates except as allowed by applicable codes and defined detailed on the plans and/or in the schedule.

B. Design of all current carrying devices or parts of the switchboard shall conform to the latest standards specified in the related section of IEEE standards except as these characteristics may be modified herein.

C. All control and secondary wiring insulated for the voltage indicated in the schedule. All primary connections shall be uninsulated except for special installation where insulation is specified, or unless insulation is required to make the equipment comply with the required dielectric test.

D. Standard test for all switching and control apparatus system 61 to 600 volts; 1500 volts for 1 minute; where the standards on devices used on this equipment call for a lower test voltage, such devices may be disconnected during the test. Voltage tests made in accordance with ASA Standard C68.1.

E. Switchboard sections constructed of code gauge steel to the dimensions indicated in the schedule or on the plans. Holes, supports, studs, and openings standardized to enable interchange or interior and front cover units. Sections fabricated with right angle corners and plumb edges and surfaces.

F. This panel is designed for installation in a certain space, the indicated **physical dimensions** are critical and **must be strictly followed.**

G. Enclosures, parkerized or bonderized as a unit after all welding has been completed, then painted with a rust-resisting prime coat of paint. Back of the enclosure and the interior finished with a coat of light grey baked enamel and the front, top, and exposed sides shall be finished with a scratch-resistant silver-grey hammer tone finish.

H. Wiring gutters extend the full depth of the switchboard front - front to back.

I. Bus bars, connection bars, and wiring on the back of the switchboard arranged so that maximum accessibility is provided for cable connections.

J. Consideration given to the arrangement of cables so they may be connected to the switchboard in an orderly manner. Electrical clearance between parts of opposite polarity and between live parts and ground shall conform to the National Electric Code.

K. Each distribution section bussed for the full connected load of the section. Bussing in all sections shall extend to all spare circuit breaker spaces, the busses drilled, taped and with straps or other mounting accessories.

L. BUS BARS: Tin, aluminum or tined copper, meeting cross sectional area of UL Standard 891 for temperature rise. The through bus shall be 100% rated, neutral bus 100% rated, provided with CU/AL lugs. Ground bus sized to UL 891.

M. AMPERE RATINGS: The switchgear shall be the rating indicated on the plans and in accordance with the latest applicable standards of IEEE and NEMA.

N. BUS BRACING SUPPORTS: The bus work shall be braced to meet the short-circuit rating indicated on the plans. Cables shall not be used in lieu of bus bars, riser busses, connection busses or bus jumpers. All bars, riser busses, connecting busses, and bus jumpers adequately supported. Bus bars of a length greater than 15" but less than 30" shall be supported with not less than one intermediate insulated support (Underwriter approved) unless the bar is taped with one layer of friction tape, half lapped, and the entire taping thoroughly varnished with approved insulating varnish. Bus bars of a length greater than 30" shall not have less than two insulated supports; sufficient supports shall be provided so that the distance between supports shall not exceed the width of the switchboard section in which they are used. Bus bars shall extend through all spare circuit breaker spaces in switchboards.

O. GROUND BUS: A ground bus shall extend throughout the length of the switchboard assembly. Each housing of the assembly shall be grounded directly to this bus.

P. The panel shall be NEMA 3R with hinged locking doors.

2.4 ACCEPTABLE MANUFACTURER

A. Subject to compliance with requirements, provide ground-fault sensing and relaying equipment of one of the following:

1. SSDi.

PART 3 - EXECUTION

3.1 GENERAL

A. Torque tighten all bolted connections of bus bars in all switchboards. All torque settings shall conform to NEMA, code and industry standards.

B. Rigidly secure and bolt switchboards to the building construction in an approved manner to resist seismic stress. Secure from the switchboard manufacturer all necessary calculations and drawings required to meet seismic conditions and be responsible for obtaining written approval of installation from proper authorities.

C. Provide approved attachments for padlocking each circuit breaker or fused switch in the OFF position.

D. The conduits connected to the switchboard shall be mounted in an approved place, the holes shall be carefully cut and sured in place with locknuts and bushings.

E. Cable connections to the main and distribution circuit breakers shall be installed in proper size lugs and torqued in place as per the manufacturer's recommendation.

F. Provide selective coordination of all breakers per NEC 700.27 and 701.27 Using the definition in Article 100 (NEC2014).

3.2 IDENTIFICATION

A. Main and distribution circuit breakers shall be labeled in accordance with the label specifications, name of Engineer and Contractor. Also install a label with the Electrical contractor and Engineer's name to be mounted on the main disconnect. See Section 260553, Labeling.

END OF SECTION 26 2413

SECTION 26 2416 – INTEGRATED PANELBOARD SECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of panelboard and enclosure work is indicated by drawings and schedules.

B. Types of panelboards and enclosure in this section include lighting and appliance panelboards, and power distribution panelboards.

1.2 QUALITY ASSURANCE *COMPLIANCE BY MAVERIK VENDOR*

A. Provide units which have been UL listed and labeled. Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC pertaining to installation of wiring and equipment in hazardous locations. Comply with NEMA Stds. Pub. No. 250, "Enclosures for Electrical Equipment (1000 volt maximum)". Pub. No. 1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

1.3 SUBMITTALS *TO BE PROVIDED VIA MAVERIK VENDOR*

A. PRODUCT DATA

1. Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.

B. SHOP DRAWINGS

1. Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one SSDi Space Saver Certified Cabinet.

B. Approved Manufacturers

1. SSDi.

2.2 PANELBOARDS

A. GENERAL

1. Except as otherwise indicated, install integrated panelboard sections supplied by Maverik. Electrical contractor shall accept deliver on site and protect integrated panel from dirt/dust during construction. Set integrated panel on 3.5” concrete curb.

B. LIGHTING AND APPLIANCE PANELBOARDS *COMPLIANCE BY MAVERIK VENDOR*

C. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangement shown, provide bolt-on thermal magnetic type branch breakers. Where multiple breakers are indicated, provide with common trip handle. Equip with aluminum bus bars full-sized neutral bus, ground bus and isolated ground bar when indicated.

2.3 PANELBOARD ENCLOSURES *COMPLIANCE BY MAVERIK VENDOR*

A. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge minimum 16-gauge thickness. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit- directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Provide enclosures fabricated by same manufacturer as overcurrent devices contained therein. Bolt engraved Formica labels indicating panel name and voltage on the interior and exterior of panelboards.

2.4 FINISH

A. Coat interior and exterior of surface with manufacturer’s standard color; baked on enamel finish.

2.5 IDENTIFICATION

A. Provide 1/16" thick black Formica labels with 1/4" high lettering on the interior and exterior of each panelboard; include panelboard name and voltage - see Section 260553.

2.6 BRANCH CIRCUIT BREAKERS *COMPLIANCE BY MAVERIK VENDOR*

A. Provide and install branch circuit breakers of the size, type and amperage indicated, mounted in the position noted in the panel schedule.

The circuit breakers shall be as defined by NEMA as a device designed to carry electric current through a set of contacts and by automatic means open the contacts, interrupting the flow of current when the flow of current exceeds the labeled rating or on a high instantaneous inrush of current. The tripped breaker shall flag the interruption of the flow of current and be capable of being reset when returned to normal operating temperature. The breaker shall be a molded case unit that will open on an overload and/or short-circuit condition.

The unit shall be constructed as molded case units having a single handle operator for one, two or three pole units. For multiple pole units, and overload on any pole shall cause all terminals to open.

PART 3 - EXECUTION

3.1 GENERAL

A. Install integrated panelboard enclosure where indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", in compliance with recognized industry practices to ensure products fulfill requirements.

B. Breaker positions shall match the schedule on the plans.

C. Coordinate installation of integrated panelboard enclosure with cable and raceway installation work. Anchor enclosure firmly to walls and structural surfaces, ensuring they are permanently and mechanically secure. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

D. Fill out panelboard's circuit directory card upon completion of installation work. Utilize actual final building room numbers, not architectural numbers used on drawings. Identify individual lighting circuits and individual receptacle circuits by room served. Includeroom number with equipment circuit designations. All directories to by typewritten.

E. Provide selective coordination of all breakers per NEC 700.27 and 701.27 Using the definition in Article 100 (NEC2014).

END OF SECTION 26 2416

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SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as a unit of an electrical system that carries or controls electric energy as its principal function.

B. Types of electrical wiring devices in this section include the following:

1. Switches
2. Receptacles
3. Cord caps and connectors
4. Low voltage switching
5. Wiring device accessories

1.2 QUALITY ASSURANCE

A. Comply with NEC and NEMA standards as applicable for construction and installation of electrical wiring devices. Provide electrical wiring devices which have been UL listed and labeled.

1.3 SUBMITTALS

A. PRODUCT DATA: Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES

A. GENERAL: Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub. No. WD 1. The devices shall be white with white coverplates.

B. Provide wiring devices (of proper voltage rating) as follows:

SWITCHES (20A Continuous Rating)				
MFGR.	1-Pole	3-Way	4-Way	W-Pilot
Hubbell	DS120W	DS320W	DS420W	HBL1221PL
P&S	2621W	2623W	2624W	PS20AC1RPL(7)
Leviton	5621-2W	5623-2W	5624-2W	1221-PLR(120v)
Eagle	7622W-Box	7623W-Box	7624W-Box	AH1221PL
Bryant	9901W	9903W	9904W	4901PLR(*)

RECEPTACLES (20A Continuous Rating)				
MFGR.	C.O.'s	GFI (Weather-Resistant)	Suppression (Blue)	IG (Orange)
Hubbell	SNAP5362W A/SNAP2RA	GFR5362WTR	IG5362SA	IG 2162
P&S	EQUAL	EQUAL	IG5362BLSP	IG 26362
Leviton	EQUAL	EQUAL	8380-IGB	16362-IG
Eagle	EQUAL	EQUAL	IG5362BLS	IG8362RN

C. Special devices as indicated on the plans, complete with matching coverplates shall be provided and installed where indicated.

D. All weatherproof covers on receptacles (GFI) and/or switches shall be mounted on a recessed box. Cover shall be made of cast aluminum such as Arlington Industries #DSHBIBRC. Equals of T&B and TayMac are acceptable. GFI receptacle shall be weather resistant as indicated in schedule above.

E. Provide devices in colors selected by Architect.

2.2 CORDS CAPS AND CONNECTORS

A. Provide 3-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment connection, and as indicated otherwise on drawings. Provide products of one of the following manufactures:

1. Arrow Hart
2. General Electric
3. Hubbell
4. Leviton
5. Pass and Seymour
6. Bryant

2.3 LOW VOLTAGE SWITCHING/DAYLIGHT SENSORS

A. Provide and install the equipment and materials necessary for the installation of low voltage switching (Daylight Sensors) network in the areas indicated on the plans. The low voltage conductors shall be installed in conduit in compliance with the specifications heretofore covered. The boxes and plates shall match the wiring device equipment heretofore covered.

B. All equipment shall be installed as per the manufacturer's instructions.

2.4 WIRING DEVICE ACCESSORIES

A. WALL PLATES: Provide and install high impact, smooth, white nylon coverplates for all wiring devices. Provide galvanized steel plates in unfinished or kitchen areas. Label all receptacle plates per specification 260533.

B. Weatherproof coverplates shall be Arlington Industries #DSHBIBRC. Equals of T & B and TayMac are acceptable.

C. Emergency power coverplate shall be "RED". Engrave "Emergency Power" on coverplate.

PART 3 - EXECUTION

3.1 GENERAL

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other trades (including painting cash wrap J-box covers, conduit in C-store, etc.), the installation of electrical boxes and wiring. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinated with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings prior to rough-in of electrical work.

C. Receptacles: **The receptacles shall be mounted vertically** with the neutral terminal or slotat the left side.

D. Install devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris. Mark each box and the back of each device plate, with felt tip marker, indicating the circuit or port to which the device is connected. Example: "CKT A-1".

E. Install blank plates on all boxes without devices.

F. Delay installation of wiring devices until wiring work is completed. Delay installation of wall plates until after painting work is completed.

G. Do not Edison or share neutral conductors between phases.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

A. At time of substantial completion, replace those items which have been damaged, including those stained, burned and scored.

3.3 GROUNDING

A. Provide electrical continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 TESTING

A. Prior to energizing circuitry, test with a hand test device that proves electrical connections: continuity, proper polarity, grounding, neutral connection, etc. Any irregularities shall be corrected.

END OF SECTION 26 2726

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor and circuit disconnect switch and/or circuit breaker is indicated on the plans and schedules. Work includes complete installation and electrical connections.

1.2 QUALITY ASSURANCE

A. Provide motor and circuit disconnect switches, and/or circuit breaker (as noted), which have been UL listed and labeled. Comply with applicable requirements of NEMA Standards Pub. No. KS 1, and NEC.

1.3 SUBMITTALS

A. PRODUCT DATA: Submit manufacturer's data including specification, installation instructions and general recommendations, for each type of motor and circuit disconnect switch required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

1. Square D Company
2. SSDi

2.2 FABRICATED SWITCHES

A. GENERAL

1. Provide heavy duty type disconnect and safety switches as indicated herein.
   a. Heavy duty switches on 240 and/or 600 volt rated circuits.
   b. HP rated switches on all motor circuits.

B. HEAVY DUTY SWITCHES

1. Provide heavy-duty type, sheet-steel enclosed switches, fusible or non-fusible as indicated of types, sizes and electrical characteristics indicated; rated 240 and/or 600 volts, 60 hertz; incorporating spring assisted, quick-make, quick-break switches which are so constructed that switch blades are visible in OFF position with door open. Provide single phase or three phase with solid neutral as required by applications. Equip with an **interlocked operating handle** which is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application, unless noted. Provide fusible switches with Class R rejection fuse clip kits.

C. FUSES

1. Where indicated, provide fuses for switches, as required of classes, types and ratings needed to fulfill electrical requirements for services indicated. Provide spare fuses amounting to one spare fuse for each 10 installed but not less than three of any onetype and size. See Section 262813 for fuse types.

D. CIRCUIT BREAKERS

1. Provide and install circuit breakers of the size noted on the plans. They shall be installed in a NEMA 1 enclosure unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer s written instructions, applicable requirements of NEC, NECA s "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirement.

B. Coordinate motor and circuit disconnect switch installation work with electrical racewayand cable work, as necessary for proper interface.

C. Install disconnect switches with motor drive appliances, and motors and controllers within sight of controller position.

END OF SECTION 26 2816

SECTION 26 2910 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicted by drawings and schedules. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboards and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.

B. Types of overcurrent protective devices in this section include the following for operationat 600 volts and above:

1. Molded case circuit breakers
2. Power circuit breakers
3. Fusible switches
4. Molded case systems breakers
5. Phase failure

C. Refer to other Division-26 sections for cable/wire and connector work required inconjunction with overcurrent protective devices.

1.2 QUALITY ASSURANCE

A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent protective devices.

1.3 SUBMITTALS

A. PRODUCT DATA: Submit manufacturer s data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.

B. SHOP DRAWINGS: Submit layout drawings of overcurrent protective devices, with layout of circuit breakers, including special relationships to proximate equipment.

C. MAINTENANCE STOCK, FUSES: For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than two units of each size and type.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S (LOW VOLTAGE)

A. Subject to compliance with requirements, provide products of one of the following (main and branch manufacturer must be same as panelboard and/or switchboard manufacturer):

1. Circuit Breakers and Fusible Switches
   a. Square "D" Co.

2.2 MOLDED CASE CIRCUIT BREAKERS

A. Provide factory-assembled, molded case circuit breakers for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers and amperage, voltage and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with mechanical screw type removable connector lugs, AL/CU rated.

B. All breakers in the main distribution panel shall have sufficient interrupting capacity to safely interrupt the available short circuit current from the transformer bank. Circuit breakers shall be Square "D", Type FH, KH, LH, MH, or as noted on the plans.

C. All breakers specified with motor starters shall be Square "D" Mag-Guard.

2.3 FUSIBLE SWITCHES

A. Provide factory-assembled fusible switch units for power distribution panelboards and switchboards, and for individual mounting as indicated. Provide switch units of amperage, voltage, and RMS interrupting rating as shown, with quick-make, quick-break mechanisms, visible blades and dual horsepower ratings. Equip with lockable handles with on-off indication. Interlock switch covers with handles to prevent opening in "ON" position. Provide switch with Class R rejection fuse clip kits.

B. Acceptable Manufacturer

1. Subject to compliance with requirements, provide ground-fault sensing and relaying equipment of one of the following (manufacturer must be same as panelboard and/or switchboard manufacturer):
   a. Square D Co.

2.4 PHASE FAILURE EQUIPMENT

A. Provide and install single phase reverse phase relay (Square "D" PR 101-PLR) that will tie to the main circuit breaker in Panel MDP to open them on abnormal service power. Provide a 120-volt source of power to operate the equipment.

B. Ground-Fault Relay

1. Provide solid-state ground-fault relay, which requires no external source of electrical power, drawing energy to operate GFP system directly from output of current sensor. Construct with adjustable pick-up current sensitivity for GF currents from 200 to 1200 amperes, with calibrated dial to show pick-up point settings. Provide factory-set time delay of 0.5 seconds and protection which precludes tampering with setting after installation.

C. Current Sensors

1. Provide zero sequence current sensors for overcurrent protective devices; inputs compatible with relay. Construct sensor frame so it can be opened to prevent removal or installation around conductors without disturbing conductors. Provide test winding in sensor for testing operation of GFP unit including sensor pick-up relay, and circuit protection device operation.

D. Monitor Panel

1. Provide monitor panel capable of indicating relay operation and provide means for testing system with or without interruption of service. Construct so GF system cannot be left in an inactive or OFF state. Provide indicator lamps and TEST and RESET control switches.

E. Acceptable Manufacturer

1. Subject to compliance with requirements, provide ground-fault sensing and relaying equipment of one of the following:
   a. Square “D” Co.

PART 3 - EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated, in accordance with the manufacturer s written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with other work as necessary to interface installation of overcurrent protective devices with other work.

C. Provide a breaker coordination study. Set field-adjustable circuit breakers for trip settings recommended in study, subsequent to installation of devices.

D. Install fuses in overcurrent protective devices.

E. Field test all ground fault protective devices for proper operation; test to be performed by representative of the manufacturer. Include verification of complete time current trip characteristics.

F. Provide selective coordination of all breakers per NEC 700.27 and 701.27 Using the definition in Article 100 (NEC2014).

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

3.3 PHASE FAILURE EQUIPMENT

A. The contractor shall have the factory representative field test the phase failure equipment by assimilating a phase failure, reversing condition to test this equipment. If it does not operate correctly, make appropriate repairs. Condition of operation shall be reported in writing to the architect in triplicate.

END OF SECTION 26 2910

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SECTION 26 2913 - ENCLOSED CONTROLLERS AND STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor starter work is indicated by drawings and schedules.

B. Types of motor starter in this section include the following:

1. AC Fraction horsepower Manual Starters
2. AC Line Voltage Manual Starters
3. AC Non-Reversing Magnetic Starters
4. AC Combination Non-Reversing Magnetic Starters

1.2 QUALITY ASSURANCE

A. Comply with NEC and NEMA Standards as applicable to wiring methods, construction and installation of motor starters. Comply with applicable requirements of UL 508, "Electric Industrial Control Equipment", pertaining to electrical motor starters. Provide units which have been UL-listed and labeled.

1.3 SUBMITTALS

A. PRODUCT DATA: Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts.

B. MOTOR VOLTAGE/CURRENT REPORT: After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage and amperage and thermal heater size installed for each motor.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements, provide products of one of the following (foreach type and rating of motor starter):

1. Allen-Bradley Co. 1
2. Square D Co.

2.2 MAINTENANCE STOCK, FUSES

A. For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not more than 5 units of each type, for both power and control circuit fuses.

2.3 MOTOR STARTERS

A. GENERAL: Except as otherwise indicated, provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated which comply with manufacturer s standard materials, design and construction in accordance with published information, and as required for complete installations.

B. THERMAL OVERLOAD UNITS: Provide thermal overload units, sized in accordance with manufacturer s recommendations for full load current of motor controlled. Provide thermal heater units, sized to actual running full load current if actual full load current is less than 90 percent of motor nameplate full load current. Size heater for mechanical equipment after air and water balancing has been completed. Spare parts: Provide a spare set of each type and/or size.

C. AC FRACTIONAL HP MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide manual, single-phase, 1 and 2 pole, 300 volt AC max, fractional HP motor starters, of types, ratings and electrical characteristics indicated; equip with one piece thermal overload relay with field adjustment capability of plus or minus 10 percent of nominal overload heater rating; for protection of AC motors of 1 HP and less. (For manually controlled motors in excess of 1 HP, see Line Voltage Manual Starters specified herein.) Provide starter with quick- make, quick-break trip free toggle mechanisms, green pilot lights, and with lock-off toggle operated handle. Mount surface units in NEMA 1 enclosures, unless noted otherwise. Provide flush mounted units with coverplate to match wiring device coverplates.

D. AC LINE VOLTAGE MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide line voltage manual starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt AC max; equip with pushbutton operator, low voltage protection feature, and green pilot light. Provide starters with trip free mechanism such that contacts will open under load and remain open until thermal element has cooled, and unit is reset. Mount surface units in NEMA 1 enclosure, unless noted otherwise. Provide overlapping trim for flush mounted units.

E. AC NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8536): Provide line voltage magnetic starters (nothing smaller than size 1 - typical all arrangements), to types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt max, 120 volt control voltage with solid state current sensing protection with under voltage trip in all phases. Equip units with holding contact, 2 normally open, and 2 normally closed auxiliary contacts, unless noted otherwise. Provide fused control transformer in each starter. Mount hand-off- auto switch, red pilot light, and reset button in face of enclosure. Provide NEMA 1 enclosure unless noted otherwise. Equip all spare starters complete with items as specified herein.

F. CONTROL CONTACTOR (EQUAL TO SQUARE D CLASS 8903 TYPE PB): Provide line voltage Contactor of the size indicated on the plans, to types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt max, 120 volt control voltage or as noted. Equip units with holding contact, 1 normally open, and 1 normally closed auxiliary contacts, unless noted otherwise. Provide fuse control transformer in each Contactor. Mount a red pilot light, in face of enclosure. Provide NEMA 1 enclosure unless noted otherwise.

2.4 SOLID STATE OVERLOAD RELAY (Include as a part of all magnetic starters)

A. The overload relay shall be a solid-state current sensing device that is ambient insensitive. The overload relay shall incorporate phase unbalance, phase loss and overload protection. The overload relay shall have a 3:1 current adjustment range. A visible trip indication and a trip test function shall be included. An LED shall indicate power to the device and there shall be a lockable tamper guard to protect the dial adjustment. The device shall be a Square D Class 9065 or approved equal.

B. AC COMBINATION NON-REVERSING BREAKER AND MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8538): Provide line voltage combination starters, of types, ratings and electrical characteristics and indicated for 8536; 2 or 3 pole, 600 volts max with non-reversing magnetic starters with solid state current sensing overload protection, as specified herein; in common cubicle or enclosure with motor circuit protector. (To include Solid State Overload Relay).

C. Provide instantaneous trip circuit breaker as indicated and adjust to comply with manufacturer s recommendations. Provide combination starters for individual mounting, or for group mounting in motor control center as indicated. Provide NEMA 1 enclosures unless otherwise indicated.

D. AC COMBINATION NON-REVERSING FUSED DISCONNECT AND MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8539): Provide line voltage combination starters, of types, ratings, and electrical characteristics; 2 or 3 pole, 600 volt maximum with non-reversing magnetic starters as specified herein; in common cubicle or enclosure with fusible disconnect switch. Provide quick-make, quick-break, visible blade disconnect switch. Provide 2, 3, and 4; and visible blade, automatic circuit interrupters with push-to-trip feature and separate fuse clips for larger NEMA sizes. Fuse all starters with dual-element (time-delay) fuses equal to Bussman FRN/FRS. Provide combination starters for individual mounting, or for group mounting in motor control centers as indicated. Provide NEMA 1 enclosures unless otherwise indicated. (To include Solid State Overload Relay).

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

A. Install motor starters as indicated, in accordance with manufacturer s written instructions, applicable requirements of NEC, NEMA standards, and NECA s "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install fuses in fusible disconnects, if any.

3.2 ADJUST AND CLEAN

A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

C. Each motor starter shall be equipped with lock out capabilities.

3.3 FIELD QUALITY CONTROL

A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 26 2913

SECTION 26 4313 - SURGE PROTECTION DEVICE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The contractor shall provide and install Surge Protection Device on main panel MDP. The unit shall be incorporated in the panel **with a by-pass** such that when maintenance is needed on the SPD unit the C-Store can remain operable.

1.2 POWER CONDITIONERS

A. The Contractor shall provide and install a 120 kA per phase TVSSS for main distribution panel. The unit shall include the following:

1. Internal monitoring capabilities (Identify internal failure)
2. EMI/RFI filtering
3. Internal fusing
4. MDV/filter (Hybrid)
5. 5 year+ warranty
6. Life expectancy of 25+ years

B. The equipment shall be mounted in a Nema 1 enclosure.

END OF SECTION 26 4313

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SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of interior and exterior luminaire work is indicated by drawings and schedules.

B. The contractor shall install owner provided luminaires indicated on the plans. The drawn length (in standard increments) of the luminaire determines the quantity and the catalog number identifies the model or type. The catalog numbers have been carefully prepared to define the luminaire type but may not be completely accurate. At least four (4) days prior to bidding each manufacturer shall compare the catalog numbers shown with the description and requirements on the drawings and shall notify the Architect/Engineer of any discrepancies.
Specifically included in the evaluation shall be the verifying of proper mounting kits or accessories to facilitate installation of the luminaire as shown at each location on the plans. No allowance or redress will be allowed for discrepancies that were not addressed to the indicated authorities for clarification prior to bidding. Reporting of ambiguities is the responsibility of the bidder.

C. Types of light sources within the luminaires shall be Light Emitting Diode (LED)

1. LED

D. The luminaires on this project are provided through a national account established with Maverik.

1.2 QUALITY ASSURANCE

A. Comply with NEC (Article 410), NEMA and ANSI 132.1 as applicable to installation of luminaires. Provide UL listed and labeled luminaires for installation on this project.

1.3 SUBMITTALS *TO BE PROVIDED VIA MAVERIK VENDOR*

A. PRODUCT DATA: Submit manufacturer s data on interior and exterior building luminaires. Submit the manufacturer’s data on ballasts supplied with luminaires.

B. SHOP DRAWINGS: Submit dimensioned drawings of luminaires and supplied ballasts. Submit luminaire shop drawings with ballasts in booklet form with separate sheet for each luminaire, assembled in "type" alphabetical order, with proposed luminaire/accessories clearly indicated on each sheet.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide LED lamps in each luminaire. Lamp color shall be 4K, except in fuel canopy (5K).

1. LED Lamps

2.2 INTERIOR LUMINAIRES *COMPLIANCE BY MAVERIK VENDOR*

A. GENERAL: Provide luminaires, of sizes, types and ratings indicated. Luminaire shall be complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters and wiring. Label each luminaire with manufacturer's name and catalog number. Provide all enclosed luminaires with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior luminaires with damp or wet location label as required by application.

B. SUPPORT REQUIREMENTS: Provide all pendant and stem mounted luminaires with flexible ball joint hangers at all points of support. Equipment hooks used to hang luminaires shall be supplied with safety latches. Provide all detachable luminaire parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain or safety cable.

Each hanger point shall be capable of supporting four times the luminaire weight. Backing supports shall be installed above (or behind) sheetrock, plaster and similar ceiling and wall materials. All surface mounted ceiling luminaires shall be supported from a structural channel. See plans for additional details.

C. Submit LED manufacturer name, telephone number, and part numbers by luminaire type so that owner can replace failed light modules after contractor's warranty period has ended.

2.3 BALLASTS/LED LAMPS/LED DRIVERS *COMPLIANCE BY MAVERIK VENDOR*

A. LED DRIVERS/LAMPS

1. 5-year warranty; lamps (4000-4500k). See additional information on Sheet E-0.0.

B. MANUFACTURES' REQUIREMENTS: Comply with manufacturer's written recommendations for all lamp/LED driver combinations.

C. OUTDOOR LUMINAIRES: Equip outdoor luminaires with low temperature starting drivers.

D. BATTERIES FOR LED DRIVERS: Provide factory installed batteries for luminaires indicated on the plans. The following also applies:

1. Shall operate luminaire lamps at approximately 1100 lumens initially and 60 percent minimum of initial lumens after 90 minutes.
2. Battery shall be capable of full recharge in 24 hours.
3. Driver shall be long life cadmium type. Driver shall be capable of full recharge in 24 hours.

4. Battery shall be complete with charging indicator light and test switch.
5. Approved Manufacturers and Models:
   a. LED Iota-4

6. Note: Size battery to number of LED lamps.

PART 3 - EXECUTION

3.1 INSTALLATION OF LUMINAIRES

A. Install luminaires at locations and heights indicated, in accordance with luminaire manufacturer s written instructions, applicable requirements of NEC (Article 410), NECA s "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.

B. Coordinate with other work as appropriate to properly interface installation of luminaires. Consult architectural reflected ceiling plan for exact location of all luminaires.

C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of luminaires. Support all ceiling mounted luminaires from the building structure; independent of the ceiling system, unless noted. Support each recessed luminaire (LED) from the building structure with #12 ga. steel wire attached to each luminaire corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. See plans for additional details.

D. Install LED battery inside luminaire driver channel with charging indicator light and test switch mounted on luminaire end, or visible and accessible through lens. Wire so luminaire can be tested with lights on and lamps in normal mode are switched off with other lighting in area. Connect emergency battery to unswitched conductor.

E. Clean luminaires of dirt and debris upon completion of installation.

F. Protect installed luminaires from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish. If repair is not possible, replace damaged portion of luminaire.

3.2 FIELD QUALITY CONTROL

A. Upon complete installation of luminaires, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning luminaires on site, then reset to demonstrate compliance; otherwise remove and replace with new luminaires and proceed with retesting.

B. Provide tight equipment grounding connections for each luminaire.

END OF SECTION 26 5100

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SECTION 26 5200 - EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install emergency batteries as described in Contract Documents at the designated locations.

B. The batteries shall be of the type, size, voltage and wattage as noted on the drawings.

C. All luminaires noted with “B” in type number as well as others indicated by keynote #1 shall be circuited directly or through a relay to an emergency panel.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Batteries

1. General
   a. Batteries shall be long life nickel cadmium type.
   b. Complete with charging indicator light and test switch.
   c. Factory-installed in luminaire, or capable of being field-installed to same standards.

2. LED Luminaires
   a. Shall operate luminaire lamps at approximately 1100 lumens initially and 60 percent minimum of initial lumens after 90 minutes.
   b. Battery shall be capable of full recharge in 24 hours.

B. Emergency Lighting Luminaires and Remote Luminaire Heads

1. Shall operate indicated number of lamps for 90 minutes of emergency operation.
2. Sealed, maintenance free, lead calcium type battery.
3. Painted steel housing and complete with power indicator light and test switch.
4. Lamps shall be 12 Watt, 12 Volts in metal housing designed for wet locations and with mounting plate that allows full vertical and horizontal adjustment of lamps.
5. Category Four Approved Products. See Section 260508 for definitions of Categories
   a. Sure-Lites/Cooper Lighting, Elk Grove, IL www.cooperlighting.com.
      1) No Lamp Unit: XR12208-0-SD
      2) Remote Two Lamp Lighting Head: 12T-12-DWWH.
   b. McPhilbin/Day-Brite Lighting, Tupelo, MS www.daybrite.com
      1) No Lamp Unit: ES12L-50W
      2) Remote Two Lamp Lighting Head: (2) MCE-MP2W

PART 3 - EXECUTION

3.1 INSTALLATION

A. Batteries

1. General
   a. Wire so luminaire can be tested with lights on.
   b. Wire so lamps in normal mode are switched off with other luminaires in area. Connect unit to unswitched conductor of normal lighting circuit.

2. Recessed Downlight LED Luminaires: If indicator light and test switch cannot be installed within luminaire, install on plate adjacent to luminaire.
3. Other LED Luminaires: Install batteries in driver channel of luminaire with charging indicator light and test switch mounted on luminaire end, or visible and accessible through lens.

END OF SECTION 26 5200

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The contractor shall install vendor provided luminaires as noted in the luminaire schedule on the plans and located as indicated. The contractor shall reference the architectural and landscaping plans and coordinate the conduit/conductor installation and light pole location therewith. If a discrepancy or conflict, refer same to the engineer for clarification.

B. The poles and luminaire provided and installed in this section shall include the driver ofthe type noted in Section 265100, except temperature-rated shall be provided, or of the type as noted in the luminaire schedule on the plans.

C. The poles shall also include the required anchor bolts for mounting and a bolt cover plate.

D. The exterior luminaires being provided for this project shall be submitted for approval with those on Section 265100.

E. The conduit/conductor installation shall comply with the specification relating to the respective section, but the conductor size shall be taken from the plans and shall complytherewith.

F. The pole base shall be constructed of 5-bag concrete of the size, shape, and dimensions as noted on the plans. The contractor shall construct the base in strict accordance thereto, setting the anchor bolts to the pole base configuration. The exterior finish of the pole base shall be hand-finished sand with all pits and voids filled, giving the base a quality appearance. After the pole has been set, the base shall be grouted, beveling the edges to drain water away from the anchor bolts. See Section 260529.

G. After the base concrete has reached 90% strength, set the pole on the base and plumb vertical, directing the luminaire as indicated on the plans.

H. Any and all scratches to the pole shall be finished to match the factory finish.

I. All pole bases shall be grounded with a No. 10 green ground that originates at the serving panel.

J. When the installation is complete, the luminaire must be clean and the area free of debris.

END OF SECTION 26 5600

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SECTIONS 27 0000 - DATA, TELEPHONE, AND TELEVISION SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 260501 Common Electrical Requirements apply to work in this section.

C. Division-23 for location of equipment.

D. Section 260533 “Raceways for Electrical Systems” apply to work in this section.

1.2 SCOPE OF WORK

A. The Auxiliary Systems of this specification are sections that have numbers greater than 270000 and 280000. This specification will include the Auxiliary Sections that are relative to this project. (See Section 260000 for listing). The materials, equipment, apparatus, etc. noted in division 26 relate directly to these sections and to be worked hand in hand with the components named in either or both. Examples: Conduit, Device boxes, support, etc. may be named in either or both specifications.

B. Each system mentioned herein is a complete system. Each network is a new system, an extension of an existing and/or a new system that incorporates an existing system into the new. Whatever the condition, the contractor shall provide all the equipment, materials, labor, etc. for a complete and operable network. Each system is specified to perform a definite function. The function and operation of a system is the final objective and whatever the requirement to accomplish that objective shall be included. If for any reason the specifications do not complete the network, the bidder and/or manufacturer’s representative shall call the deficiencies to the attention of the engineer by facsimile five (5) days prior to the bid date, so they can be included in an addendum. Failure to submit this information to the attention of the engineer does not relieve the bidder from supplying and installing the equipment needed for a complete and operable system.

C. Walk through the system when the project is complete, and **each auxiliary system** shall be tested and set into operation.

D. The contractor, the owner s and manufacturer s representative shall test each component of each system, except for the Fire Alarm System where the local fire chief shall also witness the test, for normal operation. When the test is complete, the outcome of the test shall be reported in writing to the architect and engineer that the system meets all the conditions and functions of the specifications for normal operation. Each person in the test party shall place his signature on the report.

E. Example: In the case of the Fire Detection and Alarm System, the people mentioned above plus the local Fire Marshall (or his representative) shall check out the Fire Alarm System. Each component (break glass station, heat detector, ionization detector, alarms, etc.) shall be tested individually to prove their function in the total system. Any and all defective components shall be repaired and/or replaced.

F. The factory representative shall review with the operator and administrator on their use of the equipment making sure the equipment is used to the ultimate.

G. As heretofore mentioned in this specification each auxiliary system carries a one year warranty from the date of acceptance by the owner.

END OF SECTION 27 0000

SECTION 27 0500 - TELEPHONE CONDUIT AND BOXES (CONDUIT ONLY)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide and install all the conduit, boxes, fittings, supports, etc. required for the system. See section 260533-2.1 for telephone conduit requirements.

B. The extent of the telephone system is to provide and install conduit from the point of service to the indicated outlets. Terminate the conduits in a standard device box, set at the indicated location and height. When complete install a nylon pull cord in the conduit for use of the cable installers.

C. Refer to the section 260533 and 260534 for requirements for conduit, fittings, device boxes, cover plates, etc. as applicable. The conduit installation shall comply with Section 260533 with supports as indicated.

D. Empty conduits shall include a nylon pull cord with a 24-inch pigtail at each end.

E. The owner shall provide and install the telephone system.

END OF SECTION 27 0500

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SECTION 27 1000 - DATA CONDUIT AND BOXES (CONDUIT ONLY)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Section 260501 “Common Electrical Requirements” applies to work in this section.

C. Section 260533 “Raceways for Electrical Systems” applies to work in this section.

1.2 DESCRIPTION OF WORK

A. Install conduit as required, 3/4" minimum size, for the installation of a computer system as per the drawings. The equipment shall be by others. Coordinate rough-in with the equipment supplier.

B. Where computer conduit is indicated for cabinet mounting, refer to the detail on the drawings. EMT conduit, boxes, fitting, etc. shall be fabricated and installed in the cabinet. The height shall be below the countertop and the plugs made accessible through holes in the countertop.

C. The owner shall provide and install the computer system.

END OF SECTION 27 1000

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SECTION 28 2000 - TELEVISION SURVEILLANCE SYSTEM (CONDUIT ONLY)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Division 26 Common Electrical Requirements sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Provide and install all of the conduit, devices, boxes, support, cable, etc. required for this system.

B. Install conduit as required, 3/4" minimum size, for the installation of a Television Surveillance system as per the drawings. The equipment shall be by others. Coordinate rough-in with the equipment supplier.

C. Where Television Surveillance conduit is indicated for cabinet mounting, refer to the detail on the drawings. EMT conduit, boxes, fitting, etc. shall be fabricated and installed in the cabinet. The height shall be below the countertop and the plugs made accessible through holes in the countertop.

D. The owner shall provide and install the Television Surveillance system.

END OF SECTION 28 2000

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SECTION 31 0500 –EARTHWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfills for walls and trenches.
7. Excavating and backfilling trenches within building lines.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 2 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and plantings.
2. Division 3 Section "Cast-in-Place Concrete" for granular course over vapor retarder.
3. Division 15 and 16 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:

1. 24 inches (600 mm) outside of concrete forms other than at footings.
2. 12 inches (300 mm) outside of concrete forms at footings.
3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches (150 mm) beneath bottom of concrete slabs on grade.
6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

B. Unit prices for rock excavation include replacement with approved materials.

1.4 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

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

B. Base Course: Layer placed between the subbase course and asphalt paving.

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

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

E. Drainage Course: Layer suppot1ing slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

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

H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding l cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. Yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42- inch (1065-mm-) wide, short-tip-radius rock bucket; rated at not less than 120-hp (89-kW) flywheel power with bucket-curling force of not less than 25,000 lbf (111 kN) and stick-crowd force of not less than 18,700 lbf (83 kN); measured according to SAE J -1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp (157-kW) flywheel power and developing a minimum of 45,000-Ibf (200-kN) breakout force; measured according to SAE J-732.

I. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material ¾ cu. yd. (0.57 cu. m) or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard

penetration resistance of 100 blows/2 inches (97 blows/50 mm).

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

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

1.5 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Drainage fabric.
3. Separation fabric.

B. Samples: For the following:

1. 30-lb (14-kg) samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.
2. 12-by-12-inch (300-by-300-mm) sample of drainage fabric.
3. 12-by12 inch (300-by-300-mm) sample of separation fabric.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
3. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

D. Blasting plan approved by authorities having jurisdiction, for record purposes.

E. Seismic survey agency report, for record purposes.

1.6 QUALITY ASSURANCE

A. Comply with applicable requirements of NFPA 495, "Explosive Materials Code."

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring services during blasting operations.

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

D. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2- PRODUCTS

2.1 SOIL MATERIALS

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

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch (38-

mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (38-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a l-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No.4 (4.75-mm) sieve.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

L. BACKFILL AND BEDDING MATERIAL:

1. Materials shall be installed per Section 02300
2. Backfill must meet ASTM C-33, paragraph 7.1 for quality and soundness. Backfill must be certified by supplier.
3. Pea Gravel: Must consist of clean, naturally rounded aggregate with a mix of particle sizes not less than 1/8" or more than 3/4". No more than 5% may pass the #8 sieve. Dry gravel density must be a minimum of 95 pounds per cubic foot.
4. Crushed Stone or Gravel: Must be washed with angular particle size not less than 1/8" or more than 112". No more than 5% may pass the #8 sieve. Dry gravel density must be a minimum of 95 pounds per cubic foot.
5. Sand: River or approved sand is permitted providing it shall be washed clean and is free flowing. When backfilling make sure sand is evenly distributed and packed around the piping.

M. BACKFILL AND BEDDING MATERIAL OF FUEL TANKS:

1. Install tanks per manufacturer recommendations as specified within their "installation manual & operating guidelines for fiberglass underground storage tanks." Contractor to ensure that the most current installation manual is being used and strictly adhered to and followed.
2. Primary backfill material to be used per manufacturers specifications. Secondary backfill material per manufactures specifications not to be used.
3. All secondary backfill shall be installed per the civil drawings.
4. All excavated petroleum line trenches are to be backfilled with primary backfill material per manufacturer s specifications.
5. Dead man anchors to be used as specified by the site specific geotechnical report, civil plans, and Xerxes Buoyancy Calculations.

PART 3-EXECUTION

3.1 PREPARATION

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

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

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

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared sub grades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

1. Do not damage adjacent structures, property, or site improvements or weaken the bearing capacity of rock subgrade when using explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Rock

excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock.

    a. Do not excavate rock until it has been classified and cross-sectioned by Architect.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations from 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

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

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or

conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches (300 mm) on each side of pipe or conduit.
2. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

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

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

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

3.9 UNAUTHORIZED EXCAVATION

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

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

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

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

B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch~ (1 00-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of subbase material, free of particles larger than 1” (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 FILL

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

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

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

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

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

D. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.

3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below sub grade and compact each layer of backfill or fill material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 1inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

A. Drainage Piping: Drainage pipe IS specified m Division 2 Section "Foundation Drainage Systems."

B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch (150-mm) course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 12 inches (300 mm) of filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each course of filter material to 95 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 (150 mm).

1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 698.

2. Place and compact impervious fill material over drainage backfill to final subgrade.

3.18 SUBBASE AND BASE COURSES

A. Install separation fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

B. Under pavements and walks, place subbase course on separation fabric according to fabric manufacturer's written instructions and as follows:

C. Under pavements and walks, place subbase course on prepared subgrade and as follows:

1. Place base course material over subbase.
2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
3. Shape subbase and base to required crown elevations and cross-slope grades.
4. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
5. When thickness of compacted subbase or base course exceeds 6 (150 mm), place materials in equal layers, with no layer more than 6 (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

6. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 FIELD QUALITY CONTROL

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

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

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

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

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each

100 feet (30 m) or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet (46 m) or less of trench length, but no fewer than two tests.

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

3.20 PROTECTION

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

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner s property. Stockpile or spread soil as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner s property

END OF SECTION 31 0500

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MAVERIK - HARDIN
1199 HIGHWAY 47
HARDIN, MT

SECTION 32 1216 – HOT MIX ASPHALT PAVING

PART 1- GENERAL

1.1 SUMMARY

A. Section includes asphalt concrete paving work.

B. Related Sections: Prepared aggregate subbase is specified in earthwork section.

1. At contractor s option the asphalt paving may be replaced with Portland Cement Concrete paving.

1.2 SUBMITTALS

A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with State highway or transportation department standard specifications, latest edition, and with local governing regulations if more stringent than herein specified.

1.4 SITE CONDITIONS

A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

1. Construct asphalt concrete surface course when atmospheric temperature is above 50 deg.F (4 deg.C), and when base is dry. Base course may be placed when air temperature is above 3 0 de g. F (-1 de g. C) and rising.

B. Grade Control: Establish and maintain required lines and elevations.

PART 2- PRODUCTS

2.1 MATERIALS

A. Use locally available materials and gradations which exhibit a satisfactory record of previous installations.

B. Base Course Aggregate: Sound, non-expansive angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings, I" Gradation.

1. Uncrushed gravel may be used in base course mixture if required to suit local material availability.

C. 1" Gradation Table

Ideal Gradation Ideal Gradation

Sieve Size	(Percent Passing)	Tolerance (Percent)
1”	100	+/-6
½”	85	+/-6
No. 4	55	+/-4
No. 16	31	+/-4
No. 50	19	+/-2
No. 200	9	

D. Base Course Thickness: Refer to Soils Report.

E. Surface Course Aggregate: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.

F. Sand prepared from stone, blast-furnace slag, or gravel, or combinations thereof may be used if required to suit local material availability.

G. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M 17 (ASTM D 242).

H. Asphalt Cement: AASHTO M 226 (ASTM D 3381) for viscosity-graded material and AASHTO M 20 (ASTM D 946) for penetration-graded material.

I. Tack Coat: Emulsified asphalt, AASHTO M 140 (ASTM D 997) or M 208 (D 2397); SS-1 SS-1h, CSS-1 or CSS-1h, diluted with one-part water to one part emulsified asphalt.

J. Land Marking Paint: Chlorinated rubber-alkyd type, AASHTO M 248 (FS TT -P-115), Type III.

2.2 ASPHALT-AGGREGATE MIXTURE

A. Provide plant-mix, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as recommended by local paving authorities to suit project conditions.

B. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture. Aggregate gradation shall be as follows:

Sieve Size	Ideal Gradation (Percent Passing)	Ideal Gradation Tolerance
¾"	100	0
½"	95	+/-2
3/8"	87	+/-5
No. 4	63	+/-8

PART 3- EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted base coarse surface immediately before applying herbicide treatment or prime coat.

1. Proof roll prepared base coarse surface to check for unstable areas and areas requiring additional compaction.

2. Notify Contractor of unsatisfactory conditions. Do not begin paving work until deficient base coarse areas have been corrected and are ready to receive paving.

B. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer s recommended dosages and application instructions. Apply to compacted dry base coarse prior to paving.

C. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland Cement Concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.

1. Allow to dry until at proper condition to receive paving.

2. Exercise care in applying bituminous materials to avoid smearing on adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2 PLACING MIX

A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of225 deg.F (107 deg.C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.

B. Paver Placing: Place in strips not less than 1 0 wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing

surface course.

C. Joints: Make joints between old and new pavements or between successive days work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

D. Asphalt adjacent to concrete curb and gutter, concrete waterways, catch basins or other drainage structures shall be compacted to an elevation of 1/4 inch above adjacent drainage structure (edge of concrete).

E. Asphalt Concrete Thickness: Provide a minimum compacted asphalt thickness of3".

3.3 COMPACTION

A. Percentage of Maximum Density Requirements: Compact asphalt to not less than 96% of maximum laboratory density determined in accordance with ASTM D-2726-83 or ASTM D-1188-83.

3.4 ROLLING

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.

1. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

C. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

D. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

E. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened, or 24 hours, whichever is longer.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 TRAFFIC AND LANE MARKINGS

A. Cleaning: Sweep and clean surface to eliminate loose material and dust.

B. Striping: Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and non-bleeding.

C. Color: White

1. Blue: Handicap Insignia with Appropriate Stalls.
2. Red: Fire Lanes
3. White: Directional Arrows.

D. Do not apply traffic and lane marking paint until layout and placement has been verified with Owner s Representative.

E. Apply paint with mechanical equipment to product uniform straight edges. Apply 2 coats at manufacturer s recommended rates.

3.6 FIELD QUALITY CONTROL

A. Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Engineer.

B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

1. Base Course: 1/2-inch, plus or minus.
2. Surface Course: 1/4-inch, plus or minus.

C. Base Course Testing: Owner shall employ testing laboratory to perform at least one density test on aggregate base course for each 200 c.y. (1200 s.y. at 6-inch) of material placed.

D. Asphalt Testing: Owner shall employ testing laboratory to perform at least one (1) coring sample of asphalt taken for every 100 C.Y. (1440 S.Y. at 2-112 inches and 1200 S.Y. at 3-inches) of asphalt installed to verify asphalt density, temperature and thicknesses are in conformance with specifications. The testing agency shall locate coring sites for owner. The asphalt contractor is responsible for repair of core holes. Owner shall employ testing laboratory to provide laboratory testing for materials check on bituminous materials, including but not limited to gradation, extraction, compaction, marshall density, stability, flow and % AC.

E. Surface Smoothness: Test finished surface of each asphalt concrete courses for smoothness, using 1 0-foot straightedge applied parallel with, and at right angles to

centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.

1. Base Course Surface: 1/4-inch.
2. Wearing Course Surface: 3/16-inch.
3. Check surface areas at intervals as directed by Engineer.

END OF SECTION 32 121

SECTION 321313- CONCRETE PAVING

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag,

1.4 SUBMITTALS

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

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10-lb (4.5-kg) Sample of each mix.

E. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures

when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

F. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

G. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

H. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing readymixed 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" (Quality Control Manual - Section 3, "Plant Citification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTME 329 for testing indicated.

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

D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. ACI Publications: Comply with ACI 1 (ACI 30 I M) unless otherwise indicated.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 (2400 mm) by 96 inches (2400 mm) Retain first subparagraph below if mockups are not only for establishing appearance factors.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces. Per manufacture specs.

PART 2- PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/ A 615M, 60 (Grade 420); deformed.

F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, 60 (Grade 420), deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82/ A 82M.

J. Deformed-Steel Wire: ASTM A 496/A 496M.

K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated.

L. Joint Dowel Bars: ASTM A 615/A 615M, 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A *175M;* with ASTM A 615/A 615M, 60 (Grade 420), plain-steel bars.

N. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

0. Hook Bolts: ASTM A 307, A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, gray Portland cement type as directed by soils report.

a. Fly Ash: ASTM C 618.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, cement.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source [with documented service-record data of at least 10 years satisfactory service in similar paving applications and sea-vice conditions using similar aggregates and cementitious materials].

1. Minimum to Maximum Coarse-Aggregate Size: 1 inch – 1-1/2-inch nominal
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, to inches long.

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. Monofilament Fibers:

1) Axim Italcementi Group, Inc.; FIBRASOL II P.
2) Euclid Chemical Company (The), an RPM company; Fiber strand 100, Fiber strand 150.
3) PORTA Corporation; FORTA ECONO-MONO or FORTA Mighty-Mono.
4) Grace, W. R. & Co.- Conn.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) QC Construction Products; QC FIBERS.

b. Fibrillated Fibers:
1) Axim Italcementi Group, Inc.; FIBRASOL F.
2) Euclid Chemical Company (The), an RPM company; Fiber strand F.
3) FORT A Corporation; FORTA Econo-Net or FORT A Super-Net.
4) Grace, W. R. & Co.- Conn.; Grace Fibers.
5) Propex Concrete Systems Corp.; Fibermesh 300.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following or as approved by architect:

    a. BASF Construction Chemicals, LLC; Confilm.
    b. Conspec by Dayton Superior; Aquafilm.
    c. Dayton Superior Corporation; Sure Film (J-74).
    d. Euclid Chemical Company (The), an RPM company; Eucobar.
    e. Kaufman Products, Inc.; VaporAid.
    f. Lambeti Corporation; LAMBCO Skin.
    g. L&M Construction Chemicals, Inc.; E-CON.
    h. Meadows, W. R., Inc.; EV APRE.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, provide the following or as approved by architect:

    a. ChemMasters; Safe-Cure Clear.
    b. Conspec by Dayton Superior.
    c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    d. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
    e. Kaufman Products, Inc.; Thinfilm 420.
    f. Lambert Corporation; AQUA KURE - CLEAR.
    g. L&M Construction Chemicals, Inc.; L&M CURER.
    h. Meadows, W. R., Inc.; 1100-CLEAR SERIES.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

1. Products: Subject to compliance with requirements, provide one of the following or as approved by architect:

    a. ChemMasters; Safe-Cure 2000.
    b. Conspec by Dayton Superior.
    c. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
    d. Kaufman Products, Inc.; Thinfilm 450.
    e. Lambert Corporation; AQUA KURE - WHITE.
    f. L&M Construction Chemicals, Inc.; L&M CURE R-2.
    g. Meadows, W. R., Inc.; 1100-WHITE SERIES.

2.6 RELATED MATERIALS

A. Joint Fillers: see pavement joint sealants.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, actylic emulsion or styrene butadiene.

1. 7 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, colors complying with FS TT-P-1952.

1. Color: As indicated.

B. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: As indicated.

C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than [three] [45] minutes.

1. Color: As indicated.

D. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: As indicated.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): (27, 6 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.47
3. Slump Limit: 4 inches (100 mm), plus or minus 1 (25 mm).

C. Add air-entraining admixture at manufacturer s prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.
2. Air Content: 6 percent plus or minus 1.5 percent for l-inch (25-mm) nominal maximum aggregate size.
3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer s written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage by weight of cementitious materials other than Portland cement according to ACI 301 (ACJ 301M) requirements for concrete exposed to deicing chemicals. as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer s recommended rate, but not less than (0, 90 kg/cu. m).

H. Color Pigment: Add color pigment to concrete mixture according to manufacturer s written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 7 5 minutes; when air temperature is above 90 F (3 2 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. Yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional! cu. Yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.10 EXTERIOR WATER REPELLENT COATING

A. Acceptable manufacturers and products for Cast-in-place and precast concrete.

1. V-Seal 102 Winter Guard, VSeal Concrete Sealers & Concrete Coatings 1-877-738-7325

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
Proof-roll prepared subbase surface below to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tons).
3. Correct subbase with soft spots and areas of pumping or rutting per soils engineer. Proceed with installation only after unsatisfactory conditions have beencorrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at

least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement.

F. Repair cut and damaged zinc coatings with zinc repair material.

G. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

H. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum (50-mm) overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated. Coordinate all joint locations with architect.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-112 inches (38 mm) into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 10 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 112 inch (13 mm) or more than 1 (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, laceor clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces. Tool joints only where indicated on construction drawings. All other joints shall be sawed joints.

    a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a radius as indicated. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces. Tool joints only where indicated on construction drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

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

1. When air temperature has fallen to or is expected to fall below F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 F (l 0 deg C) and not more than 80 F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 30 lM) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control

temperature provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

I. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float finished concrete surface l/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch (1.6 mm).

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.

3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/2 inch.
    a. For ADA accessible routes elevations shall have a tolerance of 1/4 inch and slopes shall not exceed those specified by ADA requirements or drop below 1.0% in primary drainage flow direction.
    b. For Underground Storage Tank Pad elevations shall have a tolerance of 1/4 inch, grading at fuel lids must meet Maverik design standard detail specifications regardless of tolerance and slopes cannot drop below 1.0% in primary drainage flow direction.
    c. Maverik Construction Manager my require concrete pavement areas and sidewalk be 'puddle/flood' tested at general contractor's expense if all areas are not compliant or any standing water is observed in order to establish materials replacement required.
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: per 12 (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 (25 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 per 12 (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 (6 mm), no minus.
10. Joint Width: Plus l/8 (3 mm), no minus.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before startingpavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer s recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of6lb/gal. (0.72 kg/L).

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 33 cu.yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day s pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day s pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1 064/C 1 064M; one test hourly when air temperature is 40 F (4.4 deg C) and below and when it is 80 F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 1373 - PAVEMENT JOINT SEALANTS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within Portland cement concrete pavement.

2. Joints between Portland cement concrete and asphalt pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Compatibility and Adhesion Test Reports: From joint sealant manufacturer indicating the following:

1. Materials forming joint substrates and joint-sealant backer materials have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: From a qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer s written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 F (4.4 deg C).

2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2- PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer s full range for this characteristic.

2.2 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

C. Available Products: Subject to compliance with requirements, cold-applied joint sealants that may be incorporated into the Work include:

D. Products: Subject to compliance with requirements, provide the following:

1. Type SL elastomeric sealant (JET FUEL RESIST ANT)

a. Sikaflex -2c SL (ALL CONCRETE JOINTS)

2. W.R. Meadows, Sealtight, Gardox joint sealant (ALL CONCRETE TO ASPHALT JOINTS.)

2.3 JOINT -SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

A. Primers: Product 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.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting jointsealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer s written instructions.

B. Joint Priming: Prime joint substrates where indicated or 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer s written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials 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 backer materials.

2. Do not stretch, twist, puncture, or tear backer materials.

3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.

2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint sealant manufacturer s written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 1373

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SECTION 32 3113 -CHAIN-LINK FENCES AND GATES

PART 1- GENERAL

SEE CONSTRUCTION DRAWINGS TO DETERMINE IF THIS SECTION IS APPLICABLE.

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Gates: swing.

B. Related Section s include the following:

2. Division 3 Section "Cast-in-Place Concrete

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:

a. Wind Speed: 100
b. Fence Height: SEE DRAWINGS
c. Line Post Group: lA, ASTM F 1043, Schedule 40 steel pipe.
d. Wind Exposure Category: see structural site analysis.

2. Determine minimum post size, group, and section according to ASTM F 1043 for framework up to plans) high and post spacing not to exceed 8 (3 m).

B. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.
4. Gate operators, including operating instructions.
5. Accessories: Privacy slats.
6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's color charts for 6-inch (150-mm) lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

D. Samples for Verification: For each type of chain-link fence and gate indicated.

1. Polymer-coated steel wire (for fabric) in 6-inch (150~mm) lengths.
2. Polymer coating, in 6-inch (150-mm) lengths on shapes for posts, rails, wires, and gate framing and on full-sized units for accessories.

E. Product Certificates: For each type of chain-link fence, and gate, signed by product manufacturer.

1. Strength test results for framing according to ASTM F 1043.

F. Qualification Data: For Installer.

G. Field quality-control test reports.

H. Maintenance Data: For the following to include in maintenance manuals:

1. Finishes.
2. Gate operator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1. Engineering Responsibility: Preparation of data for chain-link fences and gates, including Shop Drawings, based on testing and engineering analysis of manufacturer s standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CPR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency s Field Supervisor: Person currently certified according to NETA ETT, or the National Institute for Certification in Engineering Technologies, to supervise onsite testing specified in Part 3.

C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to propet1y survey and existing structures. Verify dimensions by field measurements.

B. Interruption of Existing Utility Service: Do not interrupt utility services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of utility services.

2. Do not proceed with interruption of utility services without Architect s or Owner s written permission.

PART 2- PRODUCTS

2.1 MANUFACTURERS

AA Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. As specified by Owner.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Metallic-coated wire with a diameter of0.192 (4.88

a. Mesh Size: 2 (50
b. Weight of Aluminum Coating: ASTM A 491, Type I,
c. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1, 1.2 (366 g/sq. m) with zinc coating applied before weaving.
d. Weight of Zn-5-Al-MM Aluminum-Misc. metal Alloy Coating: ASTM F 1345, Type III, Class 1, ft. (183 g/s<J. m).
e. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer s standard clear protective coating.

2. Aluminum Wire Fabric: ASTM F 1183, with mill finish, and wire diameter of inches (4.88 mm).

a. Mesh Size: 2 inches (50 mm).

3. Selvage: Knuckled at both selvages.

2.3 INDUSTRIAL FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

1. Group: IA, round steel pipe, Schedule 40.
2. Fence Height: see plans.
3. Strength Requirement: Heavy industrial according to ASTM F 1043.
4. Post Diameter and Thickness: According to ASTM F 1043.
5. Post Size and Thickness: According to ASTM F 1043.

a. Top Rail: 1.66 inches (42 mm).
b. Line Post: 1.875 by 1.63 inches (48 by 41 mm).
c. End, Corner and Pull Post: 2.875 (73 mm).
d. Swing Gate Post: According to ASTM F 900.

6. Coating for Steel Framing:

a. Metallic Coating:

1) Type A, consisting of not less than minimum 2.0-oz./sq. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.

2) Type B, zinc with organic overcoat, consisting of a minimum of 0.9

oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.

3) External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, TypeD, consisting of 81 percent, not less than (0.0076-mm-) thick, zinc pigmented coating.

4) Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. (0.55, kg/sq. m) coating.

5) Coatings: Any coating above.

b. Polymer coating over metallic coating.

7. Aluminum Finish: Mill finish complying with ASTM B 429.

2.4 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along top and bottom of fence fabric.
2. Location: Extended along top of fence fabric for supporting barbed tape.

B. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

1. Metallic Coating: Type IT, zinc coated (galvanized) electrolytic process, with the following minimum coating weight:

a. Class 1: Not less than (244 g/sq. m) of uncoated wire surface.
b. Class 2: Not less than 1.2 oz./sq. (366 g/sq. m) of uncoated wire surface.
c. Class 3: Not less than 2 ft. (61 0 g/sq. m) of uncoated wire surface.
d. Matching chain-link fabric coating weight.

2. Metallic Coating: Type III, Zn-5-Al-MM alloy with the following minimum coating weight:

a. Class 1: Not less than 0.6 oz./sq. ft. (183 g/sq. m) of uncoated wire surface.
b. Class 2: Not less than 1 oz./sq. ft. (305 g/sq. m) of uncoated wire surface.
c. Matching chain-link fabric coating weight.

C. Aluminum Wire: 0. (4.88~mm-) diameter tension wire, mill finished, complying with

B. 211 (ASTM B211 M), Alloy 6061-T94 with (344-MPa) minimum tensile strength.

2.5 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for single swing gate types.

1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.

2. Metal Pipe and Tubing: Aluminum. Comply with ASTM B 429 and ASTM F 1043 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:

1. Gate Fabric Height: As indicated.
2. LeafWidth: (914
3. Frame Members:

a. Tubular Steel 2 inches (50 mm) round.

C. Frame Corner Construction:

1. assembled with corner fittings.

D. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and keepers for each gate leaf more than 5 feet (1.52 m) wide. Padlock accessible from both sides of gate.

2.6 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.

2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
   a. Hot-Dip Galvanized Steel: (3.76-mm-) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
   b. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; (4.88-diameter, mill-finished wire.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./ sq. ft. (366 g/sq. m) zinc.

2. Aluminum: Mill finish.

2.7 PRIVACY SLATS

A. Material: PVC, UV -light stabilized, flame resistant, 4 ply, not less than 0.023 inch (0.58 mm) thick; sized to fit mesh specified for direction indicated.

B. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips.

C. Material: Fiber-glass-reinforced plastic, UV -light stabilized, not less than 0.06 (1.5 mm) thick, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips.

D. Color: As indicated on Drawings.

2.8 CAST-IN-PLACE CONCRETE

A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/C 94M.

1. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and l-inch (25-mm) maximum size aggregate.

B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer S written instructions.

2.9 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive,

nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.10 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 A WG and smaller; stranded wire for No. 4 A WG and larger.

1. Material above Finished Grade: Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel.

a. Size: 5/8 by 96 inches (16 by 2440 mm).

2.11 FENCE MATERIAL COLORS – as chosen by owner.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for [a verified survey of property lines and legal boundaries,] site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground position of posts from concrete splatter.

a. Concealed Concrete: Top 4 inches below grade to allow covering with surface material.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly at 8 feet (2.44 m) o.c.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch (3.05-mm) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (61 0 mm) o.c. Install tension wire in locations indicated before stretching fabric.

1. Top Tension Wire: Install tension wire through post cap loops.
2. Bottom Tension Wire: Install tension wire within 6 inches (150 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Bottom Rails: Install, spanning between posts.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (3 80 mm) o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (6l0 mm) o.c.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

M. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Vertically for privacy factor of 70 to 75.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer s written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware, and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner s personnel to adjust, operate, and maintain gates.

END OF SECTION 32 3113

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SECTION 32 8400 - UNDERGROUND IRRIGATION SYSTEM

PART I-GENERAL

1.1 SUMMARY

The Contractor is to have a qualified Irrigation System Specialist prepare a design for an Automatic Underground Irrigation System and submit drawings to the Engineer for approval at least 30 days prior to the system installation. (If not provided by Engineer.) Automatic Underground Irrigation System Drawings shall be prepared on 30" X 42" sheets or 24" X 36" sheets, neatly drawn and very legible. Drawings are to include head spacing, types of heads, piping with valves, backflow preventors, controllers, fittings and all other items required for proper installation of the system.

A. The Contractor shall provide all labor, materials and equipment necessary for the installation and completion of the Irrigation System as specified and shown on the drawings.

B. The Landscape Contractor shall be responsible for the installation of all irrigation sleeves prior to placement of hard improvements, coordinate with General Contractor.

1.2 WARRANTY AND MAINTENANCE

A. Fully warrant materials and workmanship for one year after final acceptance and approval by the Owner.

B. Provide maintenance of the system, cleaning and adjustments of sprinkler heads, backflow preventers, controllers, valves and all other components of the system for one year after store opening. Contractor shall provide a performance bond in the value of 20% of the underground irrigation systems installation costs for the warranty period.

C. Limit guarantee to repair and replacement of defective materials or workmanship, including repair of backfill settlement.

1.3 SUBMITTALS

A. Product Data: Complete list of materials which contractor proposes to install.

B. Shop Drawings: Provide layout, showing piping, size, valves, etc.

1.4 COORDINATION AND PROTECTION

A. Verify the exact location of all connection points, underground utilities (existing and/or proposed) and existing conditions prior to commencing construction and trenching.

1. Any portion of the Work damaged by this Section during the course of the work shall be replaced or repaired by the original installer at the cost of this contractor.

B. Repair all landscaping disturbed by the installation of the new irrigation system.

C. Balance and adjust irrigation system to ensure proper coverage and distribution.

PART 2- PRODUCTS

2.1 MATERIALS

A. Piping and Fitting

1. PVC Piping: PVC Pipe and conduits shall be Type 1120-1220 Polyvinyl Chloride (PVC) Schedule 40, Class 315 or Class 200 as indicated on the drawings. All PVC Pipe shall conform to CS-207-60.

   a. PVC Fittings: Threaded, Schedule 40 Polyvinyl Chloride (PVC) Plastic Pipe Fittings ASTM-D2462. Socket, Schedule 40 Polyvinyl Chloride (PVC) Plastic Pipe Fittings ASTM-D2466.

   b. PVC Solvent Cement: Solvent Cement for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings ASRM-D22564 and of proper consistency.

2. Galvanized Pipe and Fittings: Piping and fitting noted on the drawings to be galvanized shall be Schedule 40 Galvanized Steel Pipe and Schedule 40 Galvanized Malleable Iron Fittings.

3. Copper Piping and Fitting: Seamless Copper Water Tubing shall by Type "k" (ASTM-B88-72) and Wrought Copper and Bronze solder joint pressure fittings (ANSI-B 16.22).

4. Solder metal shall conform to ASTM-B32-70.

5. Sleeves: Shall be PVC Class 160. (Where required and as shown on the drawings.)

B. Sprinkler heads, drip emitters, valves and controllers:

1. Sprinkler Heads, Bubblers and Hose Bibs as specified on the drawings.

2. Drip Emitters shall be as specified on the drawings.

3. Valves and Hydrants: As specified on the drawings.

4. Automatic Controllers: As specified on the drawings.

5. Pressure Regulator: As specified on the drawings.

C. Other Materials

1. Valve and Meter Boxes: As specified on the drawings.
2. Wire: UF with 4/64" insulation, copper, Underwriter's Laboratory approved for direct burial when used in a National Electrical Code Class II Circuit (30 volts or less). Size #12 or as indicated on the drawings.

   a. Waterproof Wire Connectors: Weathermatic DS-100 Dri-Splice Wire Connector, Weathermatic DS-200 Crimp Sleeve, and Weathermatic DS-300 Dri-Splice Sealant or approved equal.

3. Pipe Dope/Pipe Tape: Non-hardening pipe dope compatible with PVC Pipe such as Permatex No.2, Recotrseal No. 5 or teflon pipe tape such as Scothwrap No. 50.

4. Sprinkler Risers: Quick coupling valves shall have a three ell swing joint riser assembly. These swing joint fittings shall be Marlex PVC schedule 40 and nipples PVC schedule 80 (grey). Horizontal nipple parallel to the side of the lateral line shall be eight inches long minimum. All other nipples on the swing joint riser shall be of length required for proper installation. Pop-up spray sprinkler heads, shrub heads, and bubbler heads shall have four-inch flexible risers connected directly to the lateral tee with an appropriately sized PVC schedule 40 threaded fitting and PVC schedule 80 (grey) nipple.

D. Gravel: Clean, washed, rounded stone.

PART 3- EXECUTION

3.1 GENERAL

A. Where appropriate, wiring shall be laid in the same trench as irrigation piping.

B. Provide backflow prevention assemblies. Install in accordance with requirements of authorities having jurisdiction.

1. Piping shall be located within the bed areas and at all times be located within the property boundaries. Piping within bed areas shall be located 6" minimum *I* 12" maximum from the back of all curbs, sidewalks or other site structures.

C. Install gravel sumps as required or as indicated on the drawings and details.

1. All piping installed shall be under continuous pressure at all times. In no cases shall more than 400 of piping be installed at any one time without being pressurized.

3.2 EXCAVATION

A. All trenches shall be of a minimum width of two (2) inches wider than the combined outer diameter of all piping and/or sleeving installed within the trench and shall have vertical sides and be of the depth specified below under pipe burial depth. Prior to the installation of piping and bottoms of the trenches shall be consistently level with the slope of the earth after finish grading. The bottom of the trenches shall be without humps or hollows and provide continuous bedding of each section of pipe or conduit along its entire length on undisturbed soil or thoroughly compacted fill. All trenches shall have a pipe bed of soil free of rock, stone, large clods or other debris.

3.3 PIPING/CONDUIT BURIAL DEPTH

A. Piping/conduit under paving shall be a minimum of24" deep from finished paving grade.

B. Piping/conduit in landscape areas shall be a minimum of 18" deep below finish grade.

3.4 PIPELINE ASSEMBLY

A. Install control valves where shown and group together where practical; place no farther than 18" from the edges of sidewalks, walls, or other site structures.

B. Plastic pipe and fittings shall be solvent welded using solvent cement as specified and methods as recommended by manufacturer except where threaded connections are required. Pipe and fittings shall be thoroughly cleaned of dust, dirt and moisture before applying solvent cement. After applying solvent give pipe or fitting a quarter turn to ensure even depth of the fitting socket. Hold in position for 15 seconds minimum or long enough to secure joint. Wipe off solvent appearing at outer shoulder of fitting. Do not use an excessive amount of solvent thereby causing an obstruction to form on inside of pipe.

C. Threaded Connections: Apply pipe dope/pipe tape, as specified, as recommended by the manufacturer on all threaded connections. Use PVC male adapters from all PVC to metal connections.

   1. Pipe may be assembled and welded on the surface. Snake from side to side on trench bottom to allow for expansion and contraction.

D. Install pipe under all drives, walks and other pavement, in sleeves as indicated on the drawings, to the depth as specified under Burial Depth of these specifications. Install thrust blocks as required and as indicated on the drawings, do not cover any operating devices or joints.

E. Slope all pipe to drain to low points and install drain valves as required.

3.5 SPRINKLER HEADS

A. Locate sprinkler heads or quick coupling valves no closer than twelve inches from the building foundation. Sprinkler heads or quick coupling valves adjacent to walks or curbs shall be 1" below top of walk or curb and have 4" clearance between head and walk or curb.

1. Adjust heads to specified grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering or raising of heads shall Be part of the original contract with no additional cost to the Owner.

B. Set sprinkler heads and quick coupling valves perpendicular to finish grade.

C. Adjust sprinkler heads for proper distribution and trim.

3.6 EMITTER INSTALLATION

A. Emitters shall be installed with manufacturer s recommended adapters.

B. Always place on the uphill side of plants.

C. Place at the edge of the plant rootball.

D. Emitter connections shall be barbed connections.

3.7 WIRING AND CONTROLLERS

A. Wire shall be color coded. Wire to wire connections shall be soldered and waterproofed with connectors specified under the material sections of these specifications as per the manufacturer s installation recommendation. Control wire shall be taped to the side of the water lines every ten feet minimum.

B. Splices shall be in valve boxes or thermoplastic junction boxes.

C. Electrical work shall be installed in conformance with the National Electric Code.

D. Wire shall be tested prior to backfilling to insure continuity from valve location to controller locations. Any wire not indicating continuity shall be repaired orreplaced immediately.

E. Install the specified controller in accordance with the manufacturer s recommendations in the location shown on the drawings. Verify the exact location with the Project Manager.

3.8 CLOSING OF PIPE AND FLUSHING OF LINES

A. Cap or plug openings as soon as lines have been installed to prevent the entrance of

materials that would obstruct the pipe and pressurize. Leave in place until removal is necessary for completion of installation.

B. Thoroughly flush out water lines before installing sprinkler heads, bubblers, valves and other hydrants.

3.9 HYDROSTATIC TESTS

A. Request the presence of the Project Manager in writing, at least one (1) week in advance of testing.

1. Testing to be at the expense of the contractor and in the presence of the Project Manager.

B. Center load piping with small amount of backfill to prevent arching or slipping of pipe under pressure. DO NOT backfill main or lateral lines until hydrostatic tests are completed.

C. Apply a continuous static water pressure. Submains and Mainlines to be tested for two (2) hours. Lateral lines to be tested for one (1) hour. All leaks and defects shall be corrected and lines retested.

3.10 BACKFILLING

A. DO NOT backfill until hydrostatic tests have been completed and Project Manager has inspected and approved system.

B. Backfill materials shall be soil free from rocks, stones, large clods and debris.

C. Maintain a minimum 3" clearance between piping when backfilling trenches that have more than one pipe installed in the same trench.

D. Backfilling in Planting Areas: Water, flood and compact all excavation to prevent settling. Rake excavation and adjacent areas to leave grade at previous elevations. The grade after backfilling shall be smooth and consistent with surrounding grades.

E. Backfilling under Paving: Backfill on pipe running beneath paving surfaces shall be backfilled evenly in lifts not to exceed six (6) inches and compacted to 95% maximum density, modified proctor.

3.11 AS-BUILT DRAWINGS AND MANUALS

A. Prepare an accurate as-built drawing as installation proceeds to be submitted prior to final inspection.

B. Payment for system will not be authorized until an accurate and complete as-built drawing

is submitted.

C. Provide the owner with instructions to all the equipment and recommended watering schedules.

D. Attach a typed legend inside the door of the Controller stating valve sequence and areas of coverage. Station numbering shall correspond to the drawings.

E. Review operation of system with the Owners maintenance personnel, and store manager.

3.12 SITE CLEAN-UP

A. The contractor shall keep and leave the site clean and free from debris. All trenching shall be restored to a grade consistent with the grade of surrounding areas.

END OF SECTION 32 8400

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